the Boca Chica Channel wreck:

a site assessment

Naval Historical Center
Underwater Archaeology Branch
Washington, D.C.

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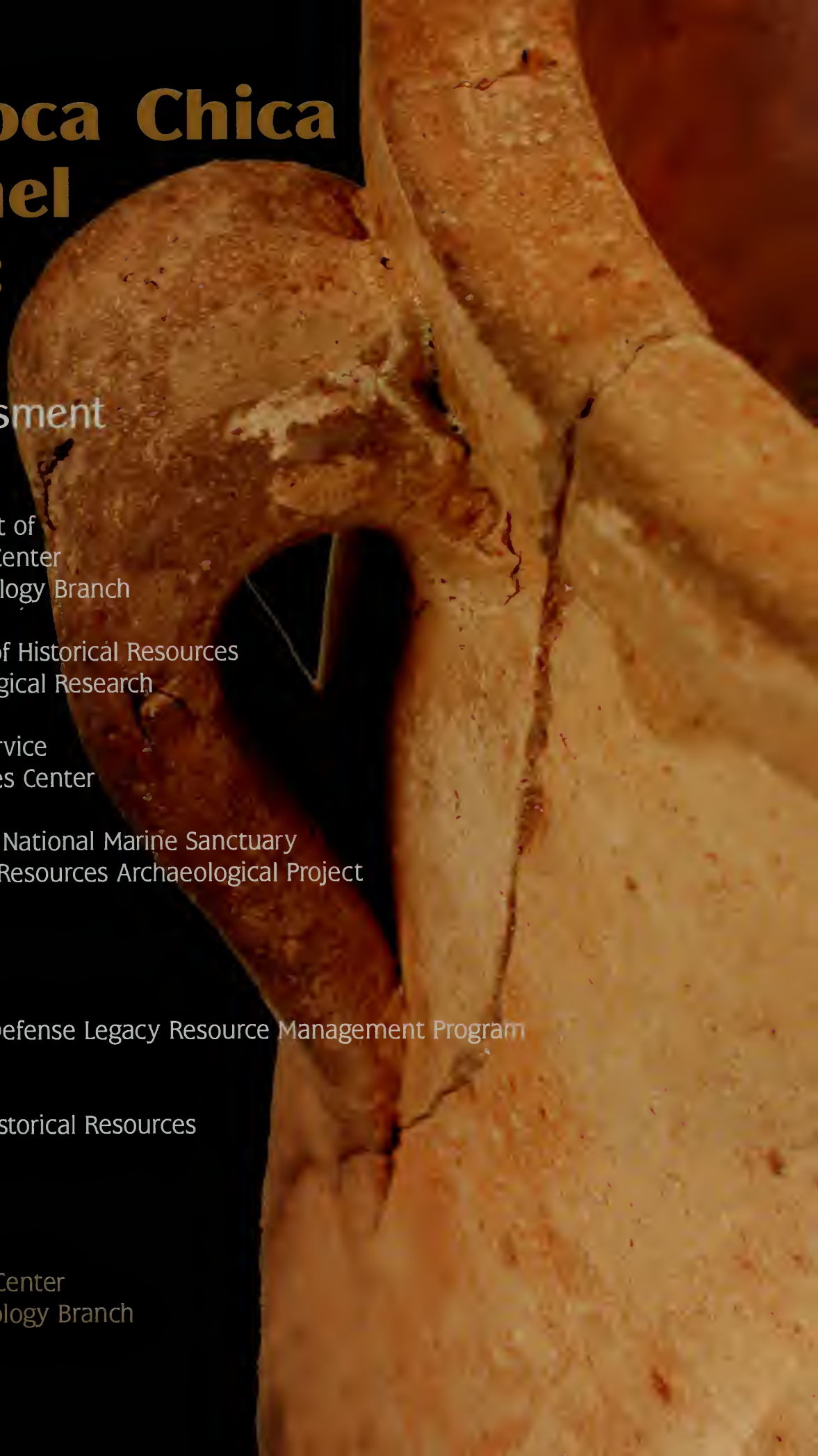

a cooperative project of
the Naval Historical Center
Underwater Archaeology Branch

the Florida Division of Historical Resources
Bureau of Archaeological Research

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Submerged Cultural Resources Archaeological Project

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A product of
the Naval Historical Center
Underwater Archaeology Branch

Roger Smith and Diane Silvia excavating around the boom iron.

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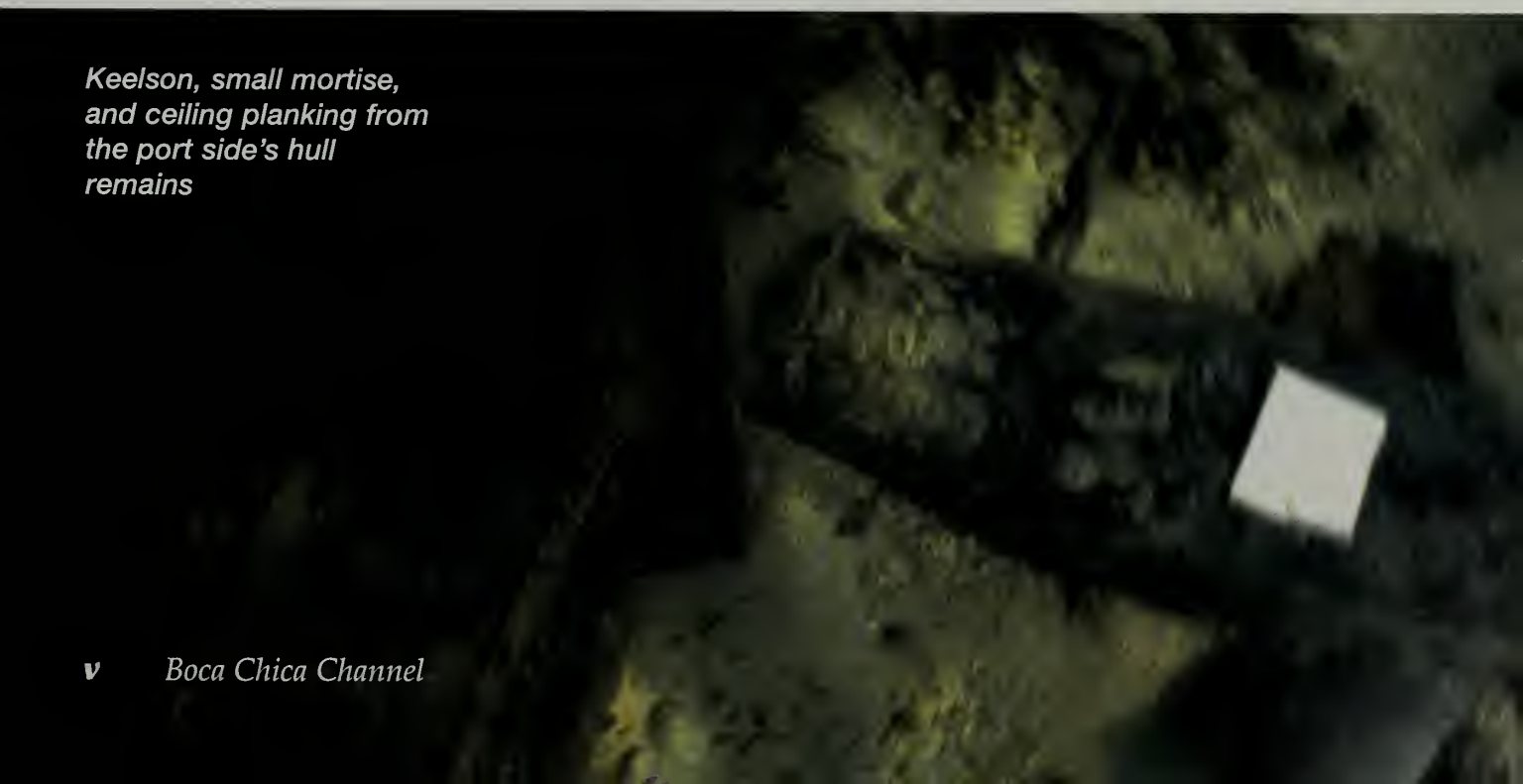


Keelson, small mortise, and ceiling planking from the port side's hull remains

Executive Summary

This report describes a joint federal and state archaeological survey and assessment of a colonial shipwreck located near Key West, Florida. Discovered by local divers in the early 1970s, the shipwreck is located in Boca Chica Channel on submerged bottomlands acquired from the state of Florida by the U.S. Navy for the Key West Naval Air Station (NAS Key West) on Boca Chica Key. Bill Muir, a local naval architect and historian, reported the shipwreck site to state officials on several occasions. Because it was outside of the state's jurisdiction, it soon became the subject of limited amateur investigations, disputes among principals of the Key West Maritime Historical Society (KWMHS), a federal admiralty court case, and a confrontation with Navy security personnel.

Concurrent with plans for joint submerged cultural resource management in the new Florida Keys National Marine Sanctuary, the Florida Division of Historical Resources (FDHR) also began a partnership with the U.S. Navy's Naval Historical Center (NHC) in 1995 to inventory, investigate, and prepare management plans for significant Navy shipwrecks in Florida's waters. Planning discussions also included non-naval sites in Florida under Navy jurisdiction, such as the Boca Chica Channel Wreck. Muir's preliminary investigations led him to conclude that the site represented an early colonial Spanish vessel based on architectural characteristics and artifact types. A cooperative project for further exploration and assessment of the shipwreck was organized by archaeologists representing the NHC, the Florida Bureau of Archaeological Research (FBAR), the National Park Service (NPS) Submerged Resources Center (SRC), and the National Oceanic and Atmospheric Administration (NOAA) National Marine Sanctuaries Program.

The project began in September 1997 with a remote sensing survey of Boca Chica Channel to locate submerged cultural features and test excavations to determine the wreck's condition and archaeological context. Survey results confirmed the wreck's location and several other man-made features in the vicinity. Examination of the shipwreck and recovery of several diagnostic artifacts for comparison with those previously recovered by Muir produced a more complete interpretation of the site as the remains of a late eighteenth-century Spanish or French colonial-built trading or fishing vessel.

In addition to these analyses and conclusions, this report offers several recommendations for further coordination of the management, protection, and public interpretation of the site as a significant regional and national archaeological resource.

Acknowledgements

Archaeological projects are the product of hard work by many individuals and agencies working together in a common cause. The assessment of the Boca Chica Channel Wreck is no exception. In fact, for a relatively small project on a limited budget, this assessment involved many individuals and agencies. Their responsibilities and contributions to different aspects of the assessment and report preparation are listed in the Project Credits. This list acknowledges individual contributions as a permanent part of the project's documentary record. However, it is also appropriate to acknowledge at the beginning of this report many of those who contributed to the success of this project.

Local support from avocational historians, archaeologists, and volunteers is essential both to preservation of archaeological sites and to a community's sense of identity. Muir's efforts to record, interpret, and protect the Boca Chica Channel Wreck have been exemplary. It is due to his enthusiasm and vigilance that the assessment and its corresponding report have been possible. Bill Blazawick also took time to revisit NAS Key West's terrestrial sites and discuss what he knew of local Boca Chica Key history. The NHC would have remained unaware of the Boca Chica Channel Wreck without the actions of Commander David McCampbell, USN (Retired), and Commander David Whall, USN (Retired). They formed a volunteer unit entitled Submerged Cultural Resources Assessment Project (SCRAP) and took an interest in this wreck site as part of a program to inventory and identify shipwrecks in the Florida Keys National Marine Sanctuary (FKNMS). Whall coordinated with Muir, relocated the site, and researched the local history. Local archaeologist Dr. Diane Silvia devoted a great deal of time to the project by identifying artifacts and researching local history.

Volunteer divers represented several agencies and local groups. NOAA's National Marine Sanctuaries Program provided the services of Bruce Terrell, archaeologist and historian. FKNMS provided a boat, fuel, a captain, and crewmember for the remote sensing survey of the Boca Chica Channel area, as well as site surveillance after the project was completed. They also provided local computer and copying services and are commended for their support of SCRAP.

FDHR provided the services of Dr. Roger C. Smith, state underwater archaeologist, and KC Smith. Dr. Smith also provided a great deal of encouragement and research support during the survey. His efforts are the primary reason that this project was initiated. FDHR also provided funding, equipment, and artifact analysis.

NPS-SRC provided the services of underwater archaeologist Matt Russell, as well as a marine magnetometer, global positioning system, and computers for the remote sensing survey, data analysis, and report preparation.

A great deal of credit is due the personnel of NAS Key West who supported and facilitated this project. Ron Demes, chief engineer, and Richard Davis, cultural resources manager, assisted with project logistics by locating lodging, a boat, and docking facilities. They also provided copies of maps and other pertinent information. A great deal of appreciation is extended to ENC King Davis and to the NAS Key West Oil Spill Response Team who provided a boat and the very able services of EN3 Paul A. (Tots) Totman. Tots served as boat captain and site security officer, patiently logged diver activity, loaded and unloaded equipment, and performed a multitude of other tasks, always maintaining good humor and a positive attitude.

Diane Silvia records timbers in the test trench.

Chapter One

Introduction

For two weeks in September 1997, a team of federal, state, and local archaeologists surveyed a small, late eighteenth-century shipwreck located in Key West, Florida, on bay bottom owned by NAS Key West. The wreck is located in the shallow waters between Boca Chica Key and the Boca Chica Channel. It is known locally as the Boca Chica Channel Wreck, or Channel Wreck, and is designated 8MO1448 in Florida's archaeological files. The existence of this wreck has been known for nearly two decades. However, until the September 1997 survey, there had not been a scientific archaeological investigation. The wreck had been identified as having an early date and initially had been believed to date to the late sixteenth or early seventeenth century. This survey determined that the ship lost in Boca Chica Channel sank during the second half of the eighteenth century. This is based on the recovered ceramic assemblage and the discovery of a single coin, dated to AD 1772 or some years thereafter. Although it does not date to as early as first believed, the Boca Chica Channel Wreck dates to a significant era of American and Caribbean history, prior to the establishment of a permanent settlement in the Florida Keys. Although the vessel's name, captain, and history is currently unknown, a date of 1772 or later for its loss coincides with the time frame of the American Revolution, a period of naval warfare and privateering in southern Florida, the Caribbean, and the Gulf of Mexico.

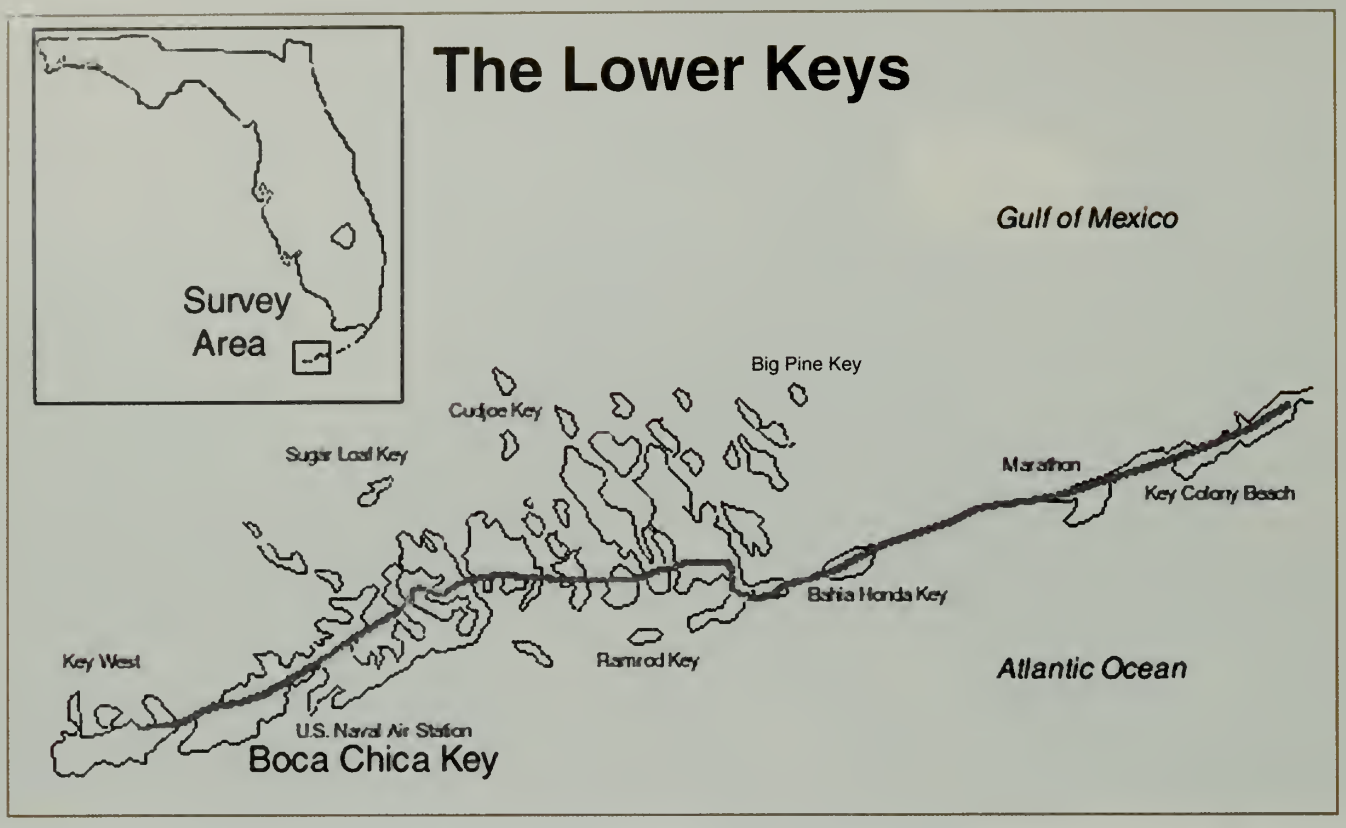


Figure 1• Key West and Boca Chica with inset showing map of Florida.

The vessel's origins and crew's ethnicity are not positively established, but there is the likelihood of French, Spanish, and Cuban connections. The Boca Chica Channel Wreck is important to the history of the Florida Keys and, if found to be associated with the American Revolution, with that of the nation.

Site Location

The Florida Keys extend over 130 miles and terminate in Key West, Florida, the southern-most extremity of the continental U.S. (Figure 1). The Keys are divided into three geographic regions consisting of the High Coral Keys (Upper Keys), Low Coral Keys (Middle Keys), and Oolite Keys (Lower Keys). Key West and Boca Chica Key are the western-most portion of the Lower Keys and are built upon a raised oolite bank (Butler 1997:7).

The wreck is located in Boca Chica Channel off the southwestern tip of Boca Chica Key. The Boca Chica Channel Wreck is located on the eastern side of the Boca Chica Channel on bottomland owned by the U.S. Navy. It is embedded within the shallow sand and coral sediments of the bay bottom off the key and is located approximately 40 feet from the shoreline in 10 feet of water. Figure 2 shows the submerged bay bottom acquisitions for NAS Key West. The wreck lies within the 100-foot wide strip running adjacent to the Boca Chica shore, an area acquired for NAS Key

West's security and explosive ordnance zone. This location is on the southwest corner of U.S. Navy property alongside the channel. The precise coordinates of 8MO1448, the state site number assigned to the Boca Chica Channel Wreck, are archived at the NHC and are restricted from public access to protect the wreck.

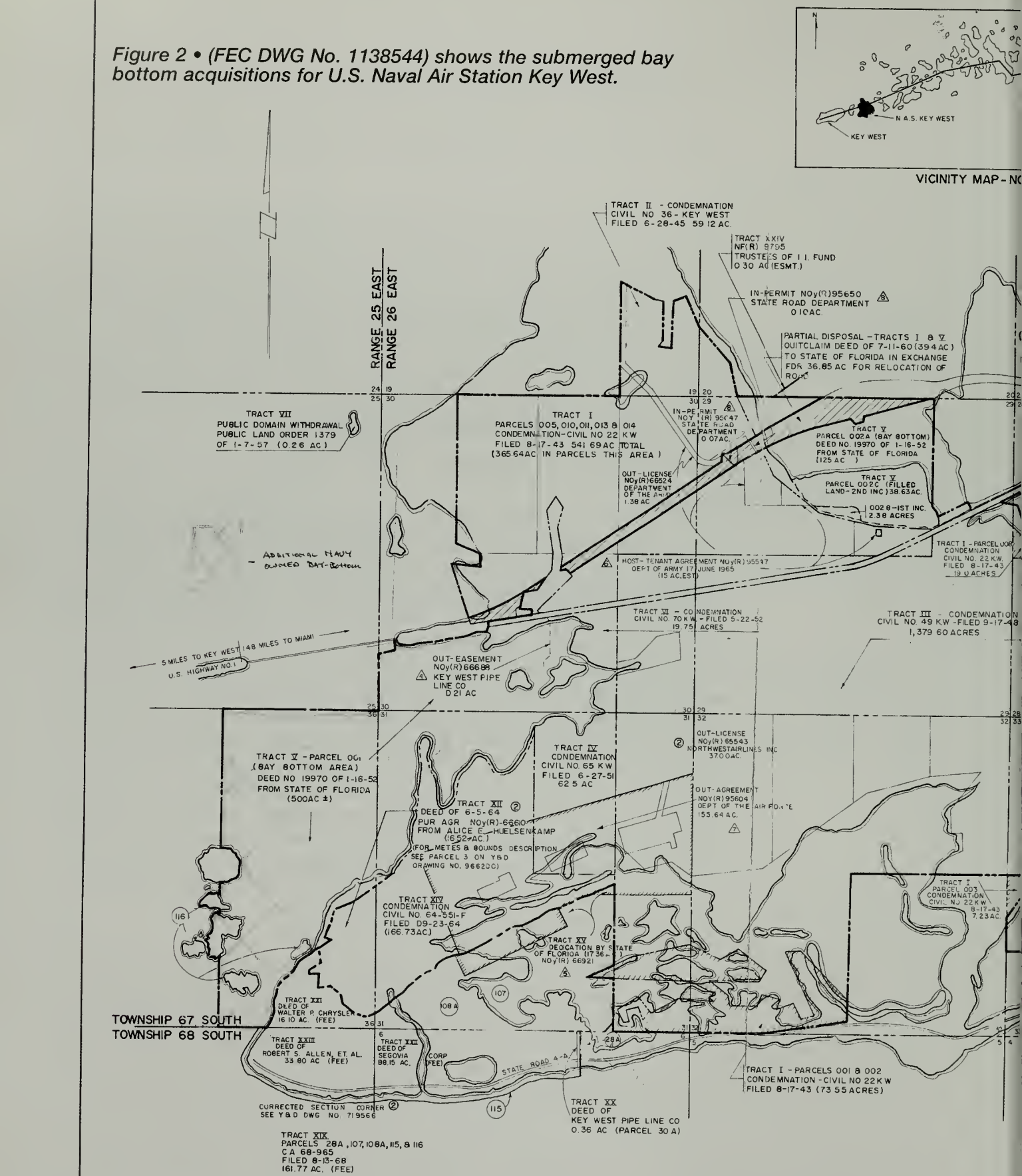
Lying at the very end of the Lower Keys, Boca Chica and Key West are well situated to be a last stop for water, provisions, repairs, and rest on the voyage between the Gulf of Mexico and the Caribbean or Florida's northeast coast. Hawk Channel lies to the south and east of Boca Chica Key. This channel, situated between the Outer Reef and the Keys Shoreline, has a counter-current flowing opposite to that of the Gulf Stream. The westerly flow of this counter-current allows vessels of shallow or medium draft to coast with the current on the journey from the Florida mainland to Havana and the Caribbean.

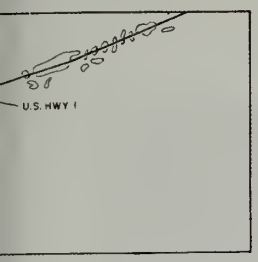
Environmental Context

An 1858 map shows Key West and Boca Chica prior to major developments and land filling operations (Figure 3). The sand beach on this peninsula was reported to have extended at least 50 to 75 feet farther westward in the 1920s than today (Muir 1991:18). Photographs of the beach from the first half of the twentieth century confirm the presence of a wide sandy beach. As late as 1952 a sandy beach extended further westward than today. Today there is only a narrow shallow sandy beach and the shoreline is now weathered limestone, with shallow sand or patches of sand-filled depressions. The wreck may have been uncovered in 1964 when the Boca Chica Channel was dredged to provide access to the Navy fuel docks located to the north of the wreck site. If the site was not uncovered during the dredging, increased boat traffic in the channel, particularly large barge traffic for the Navy fuel dock, may have increased beach and shoreline erosion. Muir attributes the uncovering of the wreck to this erosion (Muir 1991:18). The Boca Chica Key shoreline opposite the wreck contains a thick growth of mangroves, as it probably did in earlier times.

Muir reported that there was a six-foot sandbar at the natural channel's entrance. The bar was located just off the southwest shoreline and lay directly across what is today the main channel. According to Muir, only a shallow draft vessel could cross this bar. The water exchange through the channel is in a northerly and southerly direction and occurs in a regular and swift fashion. During tidal changes the current averages from 0.9 to 2.6 knots. This makes the area accessible only during slack tides and the short intervals before and after. Muir said there is only about a 30 minute tolerable work window during slack tide. Visibility on the incoming tide is relatively good but on the outgoing tide it is very limited due to a higher sediment concentration (Muir 1991:18).

Figure 2 • (FEC DWG No. 1138544) shows the submerged bay bottom acquisitions for U.S. Naval Air Station Key West.



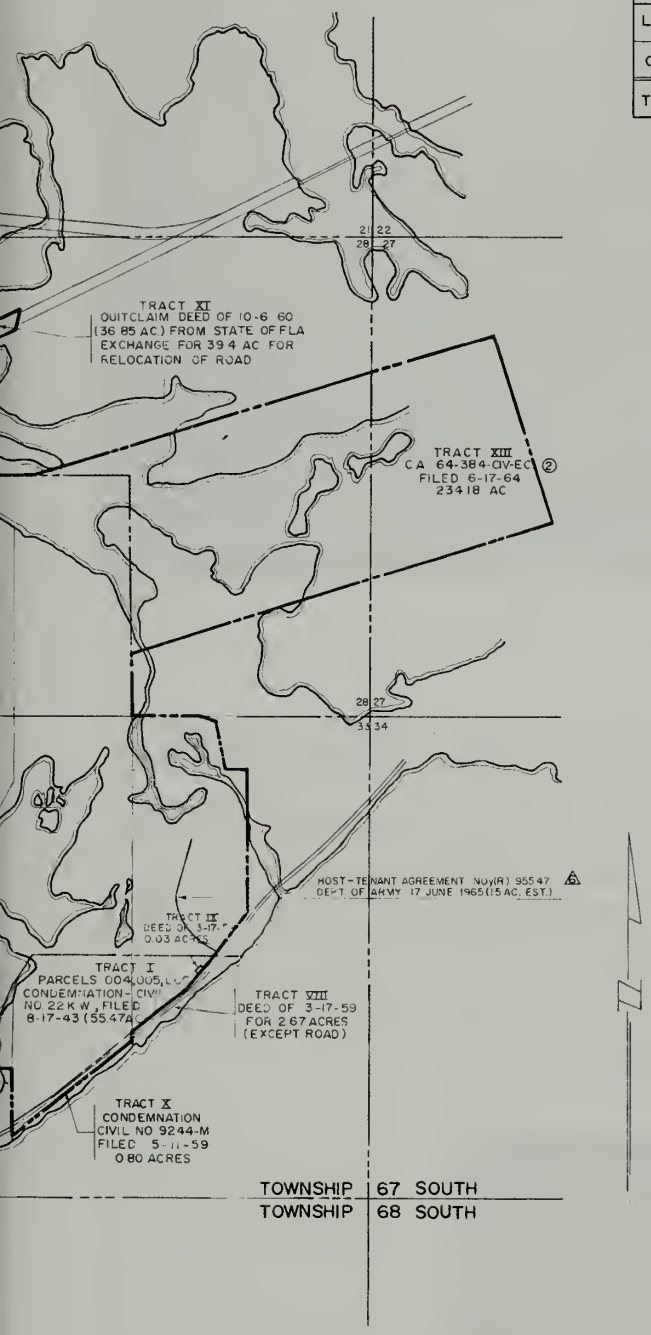


SUMMARY OF ACREAGE

ESTATE	HOW ACQUIRED							RIGHT TO USE BY OTHERS	
	PURCHASE	CONDEM.	DONATION	EXCHANGE	TRANSFER	RESERV.	TOTAL		
FEE	805.04	2605.34		36.85		0.26	3447.49	LEASE	
EASE-MENT	17.36						~~17.36~~	EASE-MENT	0.21
LEASE								PUBLIC RIGHTS	
OTHER	0.17						~~0.17~~	OTHER	209.02
TOTAL	822.57	2605.34		36.85		0.26	3465.02	TOTAL	209.23

FEDERAL JURISDICTION

LAND ACQUIRED BY	AREA	DATE ACCEPTED BY U.S.A.	STATE LANDS COMM ACTION	APPLICABLE STATE STATUTE	DEGREE
DEED	805.04	NA	NA	NA	PROP.
CONDEM.	2605.34	NA	NA	NA	PROP.
REMAINDER STATION	37.11	NA	NA	NA	PROP.



LEGEND

- GOVERNMENT ACQUISITION LINE
- GOVERNMENT BLOCK LINE
- GOVERNMENT SECTION LINE
- HOUSING AREA
- SHORE LINE
- TRACT SUBDIVISION (PARCEL)

NOTE:
IN-PERMIT NO. NOy(R)61648 DOES NOT FALL WITHIN THE BOUNDARIES OF THIS MAP.

GRAPHIC SCALE
833 0 833 1666 2500 FEET

NO.	AMD. OR COR.	DESCRIPTION OF AMENDMENT OR CORRECTION	DATE	SOUTHDIV NAVFAC APPROVAL
12	COR	PARCEL 26 REVESTED IN ORIGINAL OWNERS	11-19-74	H.S.J.
11	AMD	ADDED TRACT XXIV	12-14-70	SWS
10	AMD	ADDED TRACTS XIX, XX, XXI, XXII, XXIII	11-20-68	C.F.C.
9	COR	TRANS. 1.18 AC FROM NAVAL STATION	02-29-68	C.F.C.
8	AMD.	ADDED NOy(R) 95647 & 95650	3-10-66	C.F.C.
7	AMD.	ADDED NOy(R) 95604	10-8-65	C.F.C.
6	AMD.	ADDED NOy(R) 95547	9-8-65	T.C.M.
5	AMD	ADDED NOy(R) 66921 & UP-DATED SUMMARIES	7-1-65	T.C.M.
4		UP-DATED SUM. OF ACREAGE & ADDED NOy(R)66648	8/12/64	C.F.C.
3		TRANS. 1.18 AC TO NAVAL STATION	11-64	C.F.C.
2		UP-DATED	7-64	C.F.C.
1		UP-DATED	12-63	C.F.C.

IN-LICENSE NF(R) 97101ON LOGGERHEAD KEY) DOES NOT FALL WITHIN THE BOUNDARIES OF THIS MAP.

NOTE:
ALL LAND SHOWN LOCATED IN T-67-S, R-25-E, & R-26-E, MONROE COUNTY, FLORIDA.

TRACED BY O.E. SMITH, JUNE 10, 1966 FROM DRAWING NO. 9 ♪ 815 BY H.J. LEAMOND, JAN. 25, 1962

DRAWN H.J. LEAMOND
TRACED O.E. SMITH

SUBMITTED DATE

FOR: CO SOCASTDIVNAVFAC

DEPARTMENT OF THE NAVY—NFECHQ

U.S. NAVAL AIR STATION
KEY WEST, FLORIDA

ACTIVITY CODE 1450-484
MANAGEMENT-LANTFLT

REAL ESTATE SUMMARY MAP

APPROVED BY NFECHQ

SCALE AS SHOWN

SHEET 1 OF 1

FIC OWG NO. 1138544

ENCL (1)

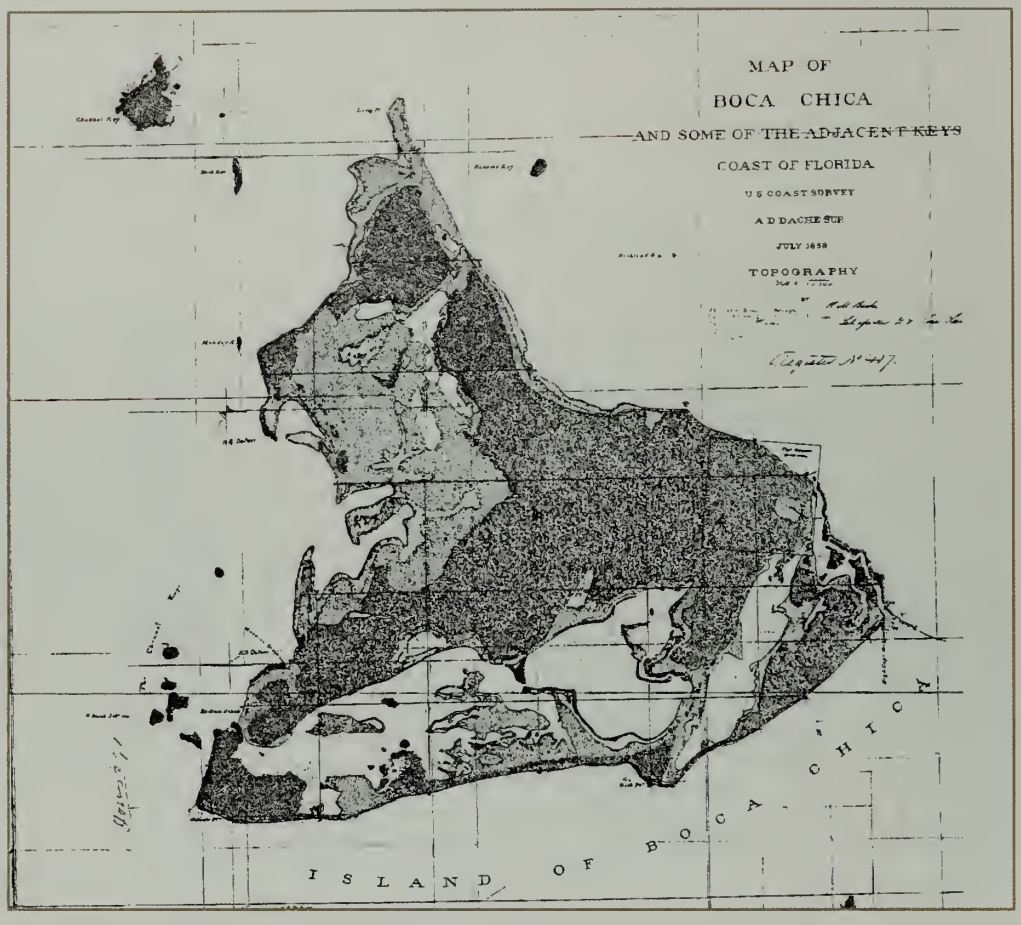


Figure 3 • An 1858 map shows Key West and Boca Chica before major developments and land filling operations.

The channel is situated between Boca Chica Key and Stock Island, with the sloping edge of the channel's east side on the Atlantic Ocean side of the key. Water depth in the channel averages 10 feet. The bottom consists of a mixture of coralline sand, shell, and benthic *Halimeda* sp. Soft corals, sea whips, occasional hard corals, and sponges cover a layer of dead corals, shell, and sand. These represent a shallow deposit overlying the limestone bedrock distinguished by numerous depressions and crevasses that contain a soft silt and clay deposit. Fish in the environs of the site include mangrove snappers, barracudas, wrasses, damselfish, angelfish, blennies, and scorpionfish.

A white ring reveals the location of a wood trunnel to help document articulated timbers.

Chapter Two

Historical Background

The history and development of the Florida Keys is summarized to place the Boca Chica Channel Wreck in its historical perspective, delineate likely circumstances for its wrecking on Boca Chica Key, and explain the presence of intrusive artifacts on the wreck site. Because the wreck dates to the second half of the eighteenth century, a more thorough discussion of the maritime history of the Lower Keys is provided for this period. This period is marked by such events as the establishment of Cuban fishing camps, or *ranchos*, and Spanish naval operations during the American Revolution.

Early History

Hann (1991:312-313) provides a historical description of the Keys excerpted from *Geografía y Descripción Universal de las Indias 1575*:

> From the farthest point of the mainland, which is at 25 degrees, it runs towards the sea on a northeast-southwest orientation until at 24 1/2 degrees it becomes a chain of

> shoals full of little islands that they call the Martyrs. And they are countless, with the greater part of them inhabited by Indians subject to the cacique, Carlos, great archers and spear throwers. One may sail among them with light drafted vessels and canoes. All the islands are covered with trees, although many of them are frequently inundated ... The long and big island, which is at the end of the Martyrs [Key Largo], is also inhabited by Indians, like the others, whose cacique is called Matecumbe. There is a shoal of rock along the length of the island a league and one-half to seaward, which runs the length of the island, at the foot of which there is so much water that there is no bottom in many areas. But for the one who has to go from Florida to Havana, he should go in close to the shoal for the sake of the current that is so strong that if they do not catch much wind, it will push them back.

The early history of the site of present day Key West and Boca Chica Key is not well documented prior to the U.S. taking possession in 1821 and the first U.S. colonization in 1822 (Browne 1973:9). Milanich and Fairbanks (1980:211-213) estimate that more than 100,000 Indians were living in Florida at the middle of the sixteenth century. Disease and slavery took their toll as numbers quickly dwindled to just a few hundred by the mid-eighteenth century. According to British historical accounts, by 1763 most of the remnants of these tribes had immigrated to Cuba (Romans 1962:291). There is great debate as to the ethnicity of the Keys inhabitants at the time of European contact. Hann (1991:327) believes the Costa Indians to be the original Keys natives. He describes them as semi-nomadic hunter-gatherer bands who exploited the rich marine environment. Sturtevant (1991:13) refers to them simply as Key Indians and states that they seemed to have been politically independent of their larger neighbors, the Caloosa to the northwest, and the Tekesta (Tequesta) inhabiting the Miami area. He states that by 1763, the end of the first reign of Spanish rule in Florida, they were extinct. Viele (1996:3) believes the Keys natives were a branch of the Tequesta tribe who subsisted by fishing, hunting, gathering native plants, and some agricultural cultivation. Carr (1997:69) states that archaeological evidence indicates that natives of the Keys originated on the mainland and carried their Glades Period ceramic tradition with them. They were hunter-gatherers who developed complex chiefdoms in the absence of agriculture, much like the cultures of the Pacific Northwest.

Ethnographic information on South Florida natives is derived primarily from accounts of shipwreck survivors such as Hernando d'Escalante Fontaneda who was rescued in 1566 by Menéndez (Griffin 1996:188). Fontaneda indicated that the Calusa chief Carlos was master of much of the seacoast along the Florida Keys and the Bahama Channel (Barciá

1951 translation of 1723). (Andrés González De Barciá Carballido y Zúniga was a Spanish chronicler who wrote a general history of Florida that was first published in 1723 and later translated and republished in 1951). It would appear that the Keys Indians were well adapted to a rich marine environment being expert mariners and fishermen, and later divers and salvors. They most likely paid tribute to the powerful chieftains living along the southwest Florida coast. This tributary relationship continued into the seventeenth and early eighteenth centuries at which time these indigenous tribes were displaced by the slave raids of the English-allied Creeks (Hann 1991:23,45).

Spaniards were the first Europeans to visit the Keys, although when they first arrived is the subject of some debate. Local Key West historians Windhorn and Langley (1974:9) believe Columbus may have sighted the southern Keys in 1492. Juan Ponce de León is credited with the discovery and naming of *"La Florida"* during his 1513 voyage to explore the *Isla de Beimeni Parte* (Island of Bimini) depicted in Peter Martyr's 1511 map (Gannon 1996:18). Ponce de León made landfall several times along the southeast coast whereupon he was attacked. He escaped each time and managed to capture a native to act as his guide. He navigated the Gulf Stream, possibly with help from his guide, by hugging the shore. When he rounded the Keys he named them *Los Mártires* because viewed from afar, "the rocks as they rose up seemed like men suffering" (Gannon 1996:19-20). Many speculate that the hostility of the natives indicates previous encounters with Europeans, possibly slavers, and the depiction of a land mass on Martyr's 1511 map may also hint at prior exploration (Gannon 1996:19-20).

After 1521, an increasing number of Spanish ships wrecked along the Florida Keys and the wreckage ended up in the hands of the Indians (Griffin 1996:188). Moreover, French and English pirate ships were threatening the Gulf and Atlantic trade, particularly when they sailed from Havana up the Strait of Florida (Gannon 1996:33). In 1600, Alonso de Alas penned a letter to the King of Spain suggesting the need for a fort with 100 men at the head of the Martyrs (Key West). Barciá also suggested this need as did others in 1608 and again in 1622 (Hann 1991:8-9). Although Spain understood the strategic importance of the Keys, it made no attempt to establish a fort or mission on any of the islands.

Spain's Keys strategy was to continue attempts to Christianize the Indians and ply them with gifts while maintaining a trade relationship. "The Indians traded fish, amber, tree bark, fruits, pelts, and cardinal birds, going in their canoes . . . from the Keys to Havana, ordinarily in 24 hours" (Griffin 1996:198). The Spanish in Havana continued to employ the Keys natives as salvage divers and fishermen. The single attempt to provide a missionary proved disastrous. After repeated requests for baptism and missionaries in Calusa territory, particularly in the Keys, Fray

Lopez and five recruits departed Havana on September 11, 1697. On reaching Cayo de Huesos in one and one-half days, they tarried there for almost two days before continuing on to see Chief Carlos, whom they reached early on September 18. The friars' reception soon turned hostile when the Indians learned that conversion did not mean a steady supply of provisions, gifts, and clothing. Within two months the friars requested a canoe in which to leave. They were stripped of their provisions and spent a month there, enslaved by the local natives until their eventual rescue by the same Spanish/Cuban ship master, Ensign Romero Francisco, who had brought them (Hann 1991:41). Barciá notes that in 1698, "communication between Havana and the lands of the cacique Carlos became more intensive each day . . . with the hope that . . . the Indians might soon be converted to the Catholic religion, as those on some of the islands, or Keys, had been" (Griffin 1996:198). Any conversions seem to have been only to facilitate a trade relationship. By the same token, as early as 1566, some Spaniards "married" into a chieftain's family to achieve the same ends as illustrated in this passage from Barciá:

> the Adelantado would reconnoiter the coasts of the Florida Keys, seek a good port in the Bahama Channel, and try to make friends with the caciques of the lands where he put in . . . a tempest in the Bahama Channel forced them to put into a port at the head of the keys [Key Largo] where they found a village of the cacique Tequesta, a relative of Carlos. Formerly, the Tequesta killed all Christians, but after the Adelantado became his relative by marriage to Carlos' sister he grew well disposed to them [Christians] . . . many Christians were living in a nearby village (1951:109).

Although historical records of the area are limited for the seventeenth century, it appears the Keys were continuously used by several Indian nations and occasionally by Spanish, Dutch, French, and English ships. Timber such as mahogany and logwood were an attractive commodity to harvest from the islands although mahogany was depleted by the second half of the eighteenth century (Romans 1962:292). The Keys were attractive to mariners as a location to take on provisions and water. For those with a bent for piracy or salvaging shipwrecks lost on the treacherous reefs, the islands of the Keys were sites for temporary bases of operations. The Keys were also the landmarks for Spanish fleets exiting the Caribbean from Havana through the Florida Straits. However, the uncharted reefs were a danger and numerous shipwrecks occurred. Hurricanes in 1622 and 1733 caused two great Spanish treasure fleet disasters. Salvage camps were temporarily established after both of these tragedies. Key West in particular was well situated for salvaging the ships wrecked on the surrounding reefs (Butler 1997:12).

The Florida Keys are located on a primary trade network for vessels trav-

eling between St. Augustine and Havana. Vessels followed Hawk Channel along the Florida Keys due to better protection and a one- to two-knot current running counter to the Gulf Stream. The trip from St. Augustine to Havana was through Hawk Channel and the return most likely along the Gulf Stream due to the favorable current running easterly and northerly (Muir 1986).

The Lower Keys in the Eighteenth Century

In the early eighteenth century, the Creek and Yamassee penetrated deep into Florida on slave raids, soon affecting the southernmost regions. As early as 1704, the Spanish removed the cacique of Key West and other Indians to Cuba, where most soon died. The survivors from this and a subsequent 1710 removal returned to the Keys around 1716 or 1718. At that time, Spain estimated the Indian population of the Keys to be around 6,000 (Griffin 1996:199). By 1743, the remnant population of the Key Calusa and Bocarraton Indians living at Tequesta numbered around 180 persons, half of whom were children (Griffin 1996:194). In 1761, the Uchises (Seminoles) forced the Key Indians to abandon their homes and flee to Key West. From there, they went to Havana where most died. Romans (1962:291) indicates that the last of the Calusa crossed to Havana in 1763.

The 1763 Peace of Paris forced Spain to exchange Florida to Britain for the return of the Cuban city of Havana. Thus, all Spanish territory east and southeast of the Mississippi River, including the Florida settlements, was placed under British rule. The Spanish reacted by evacuating over 3,100 of their countrymen from Florida by February 1764 (Covington 1982:17). The Treaty did not specifically mention the Florida Keys, resulting in claims from both nations to the island chain. Britain claimed they were part of Florida while Spain considered them part of Cuba (Covington 1982:17-18).

The British surveyed the Florida Keys intending to exploit resources and establish a strategic position from which to observe and raid Spanish ships. Ultimately the British did not establish settlements or military outposts there. Very few people were documented as living in the Keys; however, an English traveler observed that the Keys were still considered refuges for Calusa Indians hiding from the slave raids of the English-allied Creeks. It was during British ownership that Bahamians began to use the Keys seasonally for fishing, lumbering, and wrecking. Wrecking became a year-round occupation for some Bahamians and permanent camps were established in the Keys. It appears that this early settlement was not large and not well documented. Of the Lower Keys, Romans wrote:

> These are a heap of rocks very few small spots on them

> being cultivated, Matecombé alone would be worth attention for a settlement; all their productions are tropical not an oak to be found on any one, and pine trees on one only; but this reef and keys may be rendered serviceable in time of war, to any people who are well acquainted with them (1962:290).

The Keys held many logistical advantages during this period of conflict between Spain and Britain. The islands could be used to station vessels for their protection and to observe other ships, to take on fresh water, and for vessel repairs. Several of these spots included Matecombé, Biscay, Cayo Tabona, and Cayo Vacos and Huiso [Key West].

> At Cayo Tabona, a large ship, even of 60 guns, may ride just within the reef, and her tender can always supply her with water, either from Matecombé, or the above mentioned marsh, and key Biscay. Few vessels can come through the gulph without coming in sight of this place, and it is generally the first land made by every sail of shipping after they leave the Cuba shore (Romans 1962:291).

Nichols (1989:n.p.) observed that Key West was well situated as a location for the operation of privateers and pirates, and stated that Edward Teach and Captain William Kidd periodically operated out of Key West.

Cuban Fishing *Ranchos*

In the eighteenth century, Cuban fishing *ranchos* extended from the Keys to Mobile, Alabama. As fishing declined in Cuban waters, expeditions to the Keys played an increasing commercial role in supplying fish for domestic Cuban use and for sale to other islands such as Jamaica (Covington 1982:19). This commerce was a partnership between Cuban fishermen and native Indians who were transported to the Keys and the southwest Florida coast for this purpose. Vessels would arrive at the *ranchos* in September and the fishermen would repair or build huts, prepare nets, and stretch lines of native silk grass along racks for drying fish. The roe extracted from mullet and drum was placed in a salty solution and dried and pressed between two boards and then cured in a smoke hut with the smoke of burning corncobs (Covington 1982:20). On some islands, Cuban fishermen made permanent bases and grew vegetables for sale to the fishing vessels. Some intermarried with Indian women and sent their offspring back to Cuba for religious and vocational training. The English probably were not aware of the extent of these camps until 1768-1769.

In Florida, the British tolerated the Spanish fishing vessels because they did not want reprisals against their own vessels engaged in smuggling

goods to the Spanish colonies. In 1770, James Grant, Governor of East Florida, recognized the *ranchos*. This was done to continue British citizens' illegal trade with Cuba, which was essential to the economy of Pensacola (Covington 1982:22). During the 1760s, 300 to 400 Cuban fishermen in several dozen vessels plied the Florida coast (Cummins 1991:8). Cummins (1991:44) identifies these fishing craft as sloops. British fears of Spanish spying soon developed when the Governor of Cuba used fishing sloops to spy on the British at Pensacola, St. Augustine, and elsewhere along the Florida coast (Cummins 1992:10-11,19). The Cuban fishing *ranchos* survived the English occupation of Florida, but after the American Revolution they shifted operations to a point south of Tampa Bay near Charlotte Harbor. Occupation of these camps survived until the Second Seminole War (1835-42), at which time Americans abolished them because of a belief that Cubans were supplying the Indians with arms (Covington 1982:23).

American Revolution

In Havana, the Spanish took a keen interest in the outbreak of war between the American colonies and Britain. Since the early 1770s, Havana had been surreptitiously monitoring the British military buildup in an effort to predict British intentions toward the Spanish colonies. As early as 1776, the Captain General of Cuba based at Havana, Don Felipe Fonsdeviela, Marqués de la Torre, initiated the policy of collecting information about British forces and the American colonies. He gathered intelligence from merchants, ships' officers and crews, and East Florida Indians. He established an observation post at Cabo Corrientes to monitor traffic through the Straits of Florida, and by 1777, kept picket ships on station along the eastern coast of Cuba, the English sea lanes to Jamaica, and the Florida Straits (Cummins 1991:42,64). In early 1776, after appointment as minister of the Indies, José de Gálvez mobilized various agents to collect information on the coming revolution. Louisiana and Cuba were bases for orderly observation of the revolt and by the start of the revolution, Torre operated as the chief of an intelligence gathering system that covered Louisiana, British Florida, and various islands in the Gulf of Mexico and the Caribbean (Cummins 1991:19-25).

Spanish ministers gave conflicting advice regarding Spain's stance to the rebellion in British America. There was a general concern that the British would use the revolution of their former colonies as an excuse for an invasion of Cuba and war with Spain. There was also concern that the French recognition of the colonies' independence would draw Spain into the conflict. Spain's ambassador to France, Pedro Pablo Abarca de Bolea y Ximénez de Urrea, the Conde de Aranda, advised joining the conflict immediately while the minister of state, Don Geronimo Grimaldi, the Marqués de Grimaldi, believed such an action would lead to British capture of Spanish colonies in South America (Cummins 1991:27-28). In

late 1776 Spain decided to provide secret assistance to the rebels through the Spanish colony at New Orleans (Cummins 1991:62).

The Cuban fishing vessels were a source of information for the Spanish. Cummins (1991) provides numerous references to the use of the fishermen and their vessels for information gathering and espionage. After the outbreak of war and prior to Spain's declaration of war, the use of Cuban fishing craft for observation and communication with Spanish observers stationed in British East Florida was intensified. Miguel Chapuz, master of the *Divina Pastora*, and Lorenzo Rodríguez, captain of the *Nuestra Señora de la Regla*, were two Cubans hired by Havana's captain general for the purposes of communication with a Spanish observer stationed in St. Augustine, as well as Spanish sympathizers, Indians, and Minorcans living there (Cummins 1991:74,100-102). These two mariners regularly plied Florida's Atlantic coast throughout the late 1770s collecting much valuable information on British activities (Cummins 1991:105). It is likely that after war broke out between Britain and Spain, the fishing sloops continued as platforms for communication and observation. Eventually the British fleet was ordered to seek out and destroy Spanish camps in Florida, and seize Spanish vessels.

The Spanish role in supporting the American Revolution has been largely ignored. Spanish support was essential to the success of the revolution. Spain provided significant funding, shipped arms and supplies up the Mississippi River, and achieved significant victories against the British at Mobile and Pensacola. Spain, Cuba, and Mexico provided large sums of money that were essential to waging war, purchasing supplies, and enabling the French fleet to put to sea (Allen 1975).

One million five hundred thousand *pesos* were raised for Rochambeau and the French fleet in Havana within 24 hours by public subscription (Thomson 1976:249). This allowed him to sail and isolate the British fleet in the Chesapeake Bay. Spain provided a great deal of financial aid to the Americans during the revolution, but because most of the aid was secret, it is not easy to determine an accurate amount. A 1794 letter to the Duque de Alcúdia, estimates that for the combined years of 1776, 1777, and 1778, the Spanish government provided 7,944,906 *reales*, 16 *maravedis*, and 30,000 blankets to the American cause (Thomson 1976:244). In addition to financial aid, Spain's entry into the war tied up large numbers of British forces in Europe. Spanish forces also drove the British from the Bahamas and posed a considerable threat to other British outposts in the Caribbean (Holmes 1982:147; Thomson 1976:249).

Spanish King Carlos III ordered Bernardo de Gálvez, the interim governor of Louisiana, to defend Spanish interests on the Gulf Coast. Gálvez took as his mandate the expulsion of the British from the Caribbean. He put together a mixed force of Louisiana Creoles, army regulars, militia,

whites, blacks, and Indians. The multi-ethnic force was composed for the most part of Spanish and Cuban troops with some units from Mexico and Louisiana, and free Negro and mulatto units. The force also contained units of German, Irish, and French troops. In 1780, the Spanish force massed in Havana for an assault on Mobile. A short time after their departure on October 16 and 17, the fleet was scattered by the worst recorded hurricane to strike the Caribbean in the eighteenth century, which forced the assault to be aborted (Holmes 1982:149). This hurricane damaged some vessels and resulted in the loss of others.

Before the 1780 hurricane the Spanish force was estimated at 12,000 men. A Spanish scribe however, recorded that the force that took Pensacola in 1781 was comprised of 7,803 men. British sources agree with the latter number but note that the Spanish had additional seamen and marines in their ships of the line, frigates, snows, and sloops. A number of French troops and officers were also in service: 725 Frenchmen were mentioned as participants in the action at Pensacola. Gálvez praised the performance of his troops and officers to Carlos III. Some French officers were transferred to Spanish units prior to the Pensacola campaign and these continued in Spanish service in Louisiana (Holmes 1982:147). Irish troops at Pensacola consisted of 580 officers and men from the Hibernian Infantry Regiment (Holmes 1982:151). Mexico supplied a company of mounted dragoons as well as infantry regiments and increased their monetary subsidy to 315,000 *pesos* (Holmes 1982:146-155).

The naval forces involved in Spanish operations at Pensacola during the first of Gálvez's assaults consisted of 21 vessels including the brig *El Galveztown,* Gálvez's flagship (Holmes 1982:150). There were five warships and 31 transports for the third and final attempted assault against Pensacola on February 28, 1781. Other naval actions, including one patrol stationed in the Florida Straits, consisted of a combined Spanish and French fleet of 15 ships of the line and two frigates (Beerman 1982:134). The French squadron at Havana was listed as containing four ships of the line, two frigates, three brigs, two schooners, and a cutter (Beerman 1982:143). Vessels from this fleet arrived at Pensacola on April 19 and assisted in the final defeat of the city.

Cuban privateers went into action before the Governor of East Florida received notice of the state of war between Spain and Great Britain and a raiding party from a Cuban privateer burned the colony of New Smyrna (Wright 1975:82). The Spanish Declaration of War and subsequent attacks led the Governor of East Florida to request British Admiral Peter Parker to eliminate the Cuban fishermen in Florida, prevent the unrest of local Indians, and keep Spanish privateers at a distance (Wright 1975:82).

Nineteenth Century and United States Settlement

Great Britain ceded Florida and the Keys to Spain in 1783 under the stipulations outlined in the Treaty of Paris. Returned to Spanish dominion, the Keys continued to be used by wreckers, fishermen, and pirates. It would take U.S. ownership to establish a permanent settlement there. In 1815, Key West, or Cayo Hueso, was given to Juan Pablo Salas for his service in the Royal Artillery Corps at St. Augustine (Browne 1973:7). Salas, who never made use of his grant, sold the island to John W. Simonton of Mobile in 1822 (Browne 1973:7-9). However, this was not the only sale of the island by Salas. The other sale was to General John Geddes. Simonton evidently had better connections, as he and his partners were recognized as having clear title to the property. In 1819, the U.S. purchased Florida from Spain. Lieutenant M.C. Perry, commander of the U.S. Schooner *Shark* took possession of the island as territory and on March 25, 1822, the U.S. flag was hoisted over Key West (Browne 1973:9).

Commodore David Porter, under a congressional mandate to counter Caribbean pirates and avenge the death of Lieutenant William Allen, established a naval base at Key West. Allen was a young Navy officer and War of 1812 hero. He had been in command of the U.S. Schooner *Alligator* when he was shot and killed in Cuban waters during an engagement with pirates. Allen's violent death resulted in such public outrage that Congress supported a more vigorous effort to put an end to piracy in the West Indies and control the Florida Keys. Soon, eight light draft schooners and five 20-oared barges were stationed at Key West. The success of Porter's squadron was complete, for by 1824 "thus was ended piracy in the Caribbean Sea" (Browne 1973:73). The site of this base at Key West was given the name "Allentown" for a short time in Allen's honor.

The settlement at Key West grew rapidly due to a number of financial enterprises, including wrecking, salt manufacturing, cigar making, and sponging (Nichols 1989:n.p.). It is likely that the presence of the U.S. Navy and adjudication of salvage claims also added to the growth of Key West. In 1845 construction began on Fort Zachary Taylor and was completed in 1860. Although Florida seceded from the Union January 13, 1861, Fort Taylor remained in Union hands for the war's duration. In 1862 Key West became the headquarters of the Eastern Gulf Blockading Squadron, which was responsible for the Union blockade from Pensacola to Cape Canaveral. Captured blockade-runners were brought into Key West for adjudication. Because Key West remained in Union hands, it suffered less than most of the South. However, slave labor industries such as salt manufacture did suffer. Trades such as sponging, cigar making, and fishing continued to flourish in Key West during the late nine-

teenth and early twentieth centuries. In 1910, however, a red tide wiped out sponging as a commercial activity.

Key West became an important center of activity during the Spanish American War. Large numbers of Cuban dissidents lived in Key West and organized the Cuban Revolutionary Party there. Key West fishermen were used to run guns into Cuba for the revolutionaries (Langley and Langley 1982:28). After the loss of the USS *Maine*, many of its dead were brought to Key West and interred in the cemetery there. When the U.S. declared war against Spain in 1898, the U.S. Navy's Atlantic Fleet was deployed to Key West. This resulted in the construction of new docks and barracks, renovations of Fort Taylor, and the building of new batteries.

In the early decades of the twentieth century, Henry Flagler, a wealthy New York entrepreneur, initiated construction of a railroad to Key West. Construction began in 1905 and was completed in 1912. The railroad was dubbed the eighth wonder of the world (Parks 1968). It ran over the high ground on Boca Chica Key near the site of the Boca Chica Channel Wreck site. The railroad was used until 1935, when a severe hurricane destroyed the train and killed an estimated 1,000 people. The railway sold its track beds and bridges to the federal government, who used them to construct the Overseas Highway, U.S. 4A. The highway ran along the southern edge of the key, crossing Boca Chica Channel just south of the wrecksite. It was completed in 1938 and later renamed A1A (Butler 1997:41).

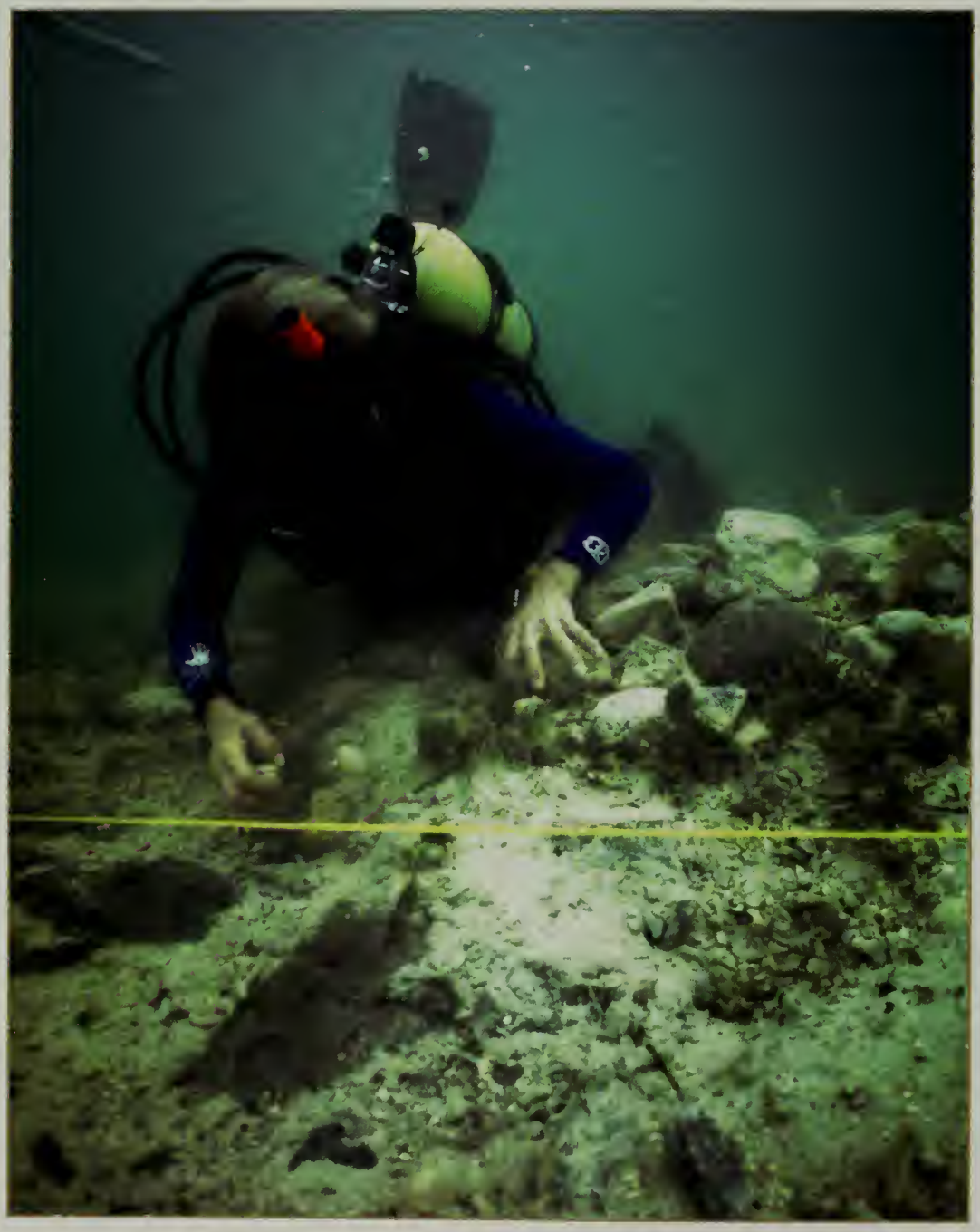
Although resort houses were located on the southwestern portion of Boca Chica during the 1930s, most development occurred during and after World War II. Monroe County acquired Boca Chica for development of a municipal airport. The Army obtained this property in 1942 and built three paved runways. In 1943 the Army transferred these to the Navy for the Boca Chica Naval Air Station, which was used to train anti-submarine warfare and aircraft carrier flight operations (Windhorn and Langley 1974:113).

Chapter Three

Archaeological History

Previous Surveys

Boca Chica Key contains the main facilities of NAS Key West. The island has been greatly altered under Navy ownership. A 1997 archaeological survey of Boca Chica Key found that much of the island's surface "has been either paved over for runway and roads or used for building sites" (Butler 1997:54). Butler found that both prehistoric and historic sites recorded on Boca Chica Key by John Goggin in 1944, and Carr and Fay in



KC Smith removes ballast stones from the wreck's hull.

1990, no longer existed due to construction (1997:56). Development on the island was so extensive that currently there is "only about five to ten centimeters of soil in locations where it was present"(Butler 1997:54).

Butler notes that "few modern archaeological investigations have been conducted in the Lower Florida Keys" (1997:8). Professional surveys include those by Goggin between 1944 and 1948, Felton and Tesar (unpublished), Historic Key West Preservation Board of Trustees (1979), Eyster's 1986 survey of a nineteenth-century pioneer settlement, Carr and Fay's 1990 survey of the Lower Keys, and the 1991 and 1996 investigations by the Mobile District Army Corps of Engineers. Other activities in the Keys have been performed by amateur archaeologists, such as Bill Fournier of Sugarloaf Key who collected Indian artifacts from Boca Chica Key, and Howard England who excavated at Fort Taylor (Butler 1997:8-9).

Research remains to be done on the history and archaeology of Boca Chica Key. Several sites are listed in the Florida archaeological site files, including a number of Indian burial mounds built of coral rock as well as a stone circle and shell midden located on a small mangrove island. Of these, only one coral rock mound still survives on Boca Chica Key. It is unknown if this is a burial mound or the aftermath of recent construction activity. Local stories about Boca Chica Key prior to its acquisition by the Navy include reports of a Mr. Geiger who was an old fisherman and beachcomber living alone in a shack on Geiger Key before the turn of the century. Geiger periodically came into Key West by boat to purchase supplies with Spanish gold doubloons supposedly found in the sands of Boca Chica Beach. Other tales relate to pirates in the area, even to tales of a pirate, known as Black Caesar (Muir to Miller, April 7, 1979).

SCRAP volunteers Whall and Silvia interviewed Bill Blazawick, a retired schoolteacher, amateur historian, and collector, to obtain information on Boca Chica Key history (Blazawick interview, October 27, 1997). Blazawick said that Bill Fournier, a local collector now deceased, reportedly discovered five flintlock guns and a Spanish helmet in sinkholes along the southwest side of Boca Chica Key. He also reported that "piles" of cannon balls and cannons were salvaged and sold from the southwest end of western Sambo Key. Blazawick said that two mounds near a large sinkhole on the Navy base were leveled and the area filled for development around 1968. These mounds were reportedly 15 feet in diameter and five feet high, and located near the present day fuel farm. He reported that there was also an old house site and cistern on the south side of the western end of Bomb Farm Road. This was confirmed by Butler's survey (1997:60). Blazawick reported that a pre-Civil War charcoal plantation owned by Geiger, and an 1890 quarantine facility were also once located on the island. These buildings were located at the site of the present day communications building on Geiger Creek. The quarantine facility consisted of eight buildings situated on the southwestern end of

the Navy property that overlooks the channel. Figure 3 shows two structures situated along Boca Chica Channel. These structures are believed to have belonged to Indian John and Lee Stephuey.

Some cultural sites are located in Navy waters or along the beaches of Boca Chica Key including the Boca Chica Channel Wreck. Other materials and sites in or near the Boca Chica Channel reported by Muir include a large anchor, perhaps lost by a modern barge, and a shipwreck. The latter consists of exposed planking and framing (Muir to Miller, April 7, 1979). Another wreck Muir located is the Boca Chica South Wreck. He describes the wreck as "limited in scope, sparse ballast well cemented to a hard bottom, some iron pins, etc., the only really distinguishing items I have seen are the large brass spikes" (Muir to Bureau of Historic Sites & Properties, April 7, 1979). Another wreck is the Geiger Key Ore Wreck, which contains some iron ore ballast, copper or Muntz metal sheathing, and bronze sheathing tacks and spikes (Muir to Bureau of Historic Sites & Properties, April 7, 1979). Nautical Chart 11445 shows three wrecks off the southern shore of Boca Chica Key. All three wrecks are outside of Navy-owned property.

The Boca Chica Channel Wreck, or 8MO1448, is one of the most significant existing sites yet identified and investigated on Navy-owned property. Unfortunately it has suffered from the dredging in Boca Chica Channel and from the activities of sport divers and relic collectors.

Discovery and Identification of 8MO1448

In 1974, Muir learned of the shipwreck in Boca Chica Channel from a Navy chief stationed at NAS Key West. The man showed Muir an intact Spanish olive jar he recovered from the site (Muir 1991). This find prompted Muir to investigate the location where the olive jar was found. Muir had a strong interest in maritime history and shipwrecks. He had helped record the hull timbers from the *Nuestra Señora de Atocha*, located a number of other wreck sites in the vicinity of Key West, and upon the founding of the Key West Maritime Historical Society for the Florida Keys, Inc. (KWMHS), in 1981, served as its secretary.

Muir 's visits to the site were brief, but his interest would last more than two decades and involve him in a dispute with the director of KWMHS, a federal admiralty court case, and a dispute with Navy security personnel. Muir reported that his dives on the site were limited to a total of nine, each lasting only 20 to 30 minutes during slack tide. His investigations were restricted to fanning the sediments by hand and moving ballast stones, sometimes with a crowbar. Muir gained a great deal of information from these brief visits and collected 18 artifacts, several hull timbers and fastener samples, and lead caulking strips. Muir also sketched a site map. The site plan was created primarily by Muir snorkeling above the

wreck and taking measurements of certain hull timbers (Muir to Neyland 1998). He reported the site to FBAR on November 13, 1992. Jim Dunbar, of FBAR's staff, assigned the Boca Chica Channel Wreck site number 8MO1448 (state of Florida files).

Muir summarized his investigations in several reports. One excerpt states:

> During a three or four month period in 1974, in approximately 1/2 hour dive sessions totaling about nine hours, of which about 7 hours was free diving, the remaining two hours with scuba gear. In most cases only one or two persons were diving the site at any tide change. All digging was by hand, and the tidal currents rapidly filled the excavations almost immediately as the currents swiftened. Ballast was scattered out to leave the site silted over to the same relative level as the surrounding bottom, to further protect the site from detection . . . A crowbar was used to break apart and tumble the stone. This was done in an attempt to camouflage the site from others. Other tools used on the site include a metal detector (1991:14).

He reported that conglomerate encrustations containing cannonballs, gunpowder, and ballast stone were found around the wreck, as were others that he took to be the remains of barrels of wadding. He listed the sizes of six pieces of shot: one 1 lb; one 9 lb; two 18-lb bar shot; one 20-lb, and a single lead musket ball. Ceramics included a complete olive jar, two rim sherds, and one body sherd. Bottle fragments included the lower half of a case bottle and several intrusive nineteenth-century bottles. Other artifacts removed from the wreck included: a gilded fork; a blue bead; a nineteenth-century blue glass goblet; a small iron boat anchor; an encrustation thought to be a possible powder horn spout; four sounding leads; and an animal bone. Samples taken for identification included: numerous ballast stones; iron nails; treenails; drift pins; 12 strips of lead caulking; and frame and planking fragments. Muir reported that the frames were of oak and the planking of cedar. He also mentioned areas of dense fibrous material that were very difficult to cut through, which he assumed to be coils of decayed hemp rope. He noted that these excluded coral and sand and that a metal detector could not read through the fibrous material (Muir 1981). The 1997 survey found similar material believed to be decaying organic material from nearby mangroves.

Muir recovered a wheelbarrow full of ballast stone that he now has in his garden (Muir to Neyland 1998). He also sent a 4-lb box for analysis to Dr. Ian Harker of the Department of Geology at the University of Pennsylvania (Muir 1974). The latter sample has never been analyzed. NPS Ranger Cullen Chambers sent a recovered iron barshot to Florida's

conservation laboratory in Tallahassee. Once treated, it was returned to Fort Taylor where it is currently on display (Muir personal communication 1997). A few artifacts including the complete olive jar, rim sherds, and sounding leads, are in private hands and their location is unknown. It is recommended that these items be located and returned to Navy custody.

Muir also observed or retrieved additional items from the wreck or its environs that he considered intrusive, but worthy of noting:

> An iron object appearing to be coral encrusted 2" shaft with oval ring at center, and 2 circular rings affixed at right angles near center of oval . . . Heavy cast iron object, coral encrusted, with iron masses of irregular shape affixed to under side, to which was attached a pair of scissors, coral encrusted, mostly intact, of powder oxide condition (seems identical with pair of scissors I have had for some 20 years in use in my office, but obviously must be much older, loops & slants same). One railroad spike, coral encrusted, found near wreck site toward bridge embankment. Ten red clay bricks, varying sizes approx. 3 3/8," 1/8" x 7 3/4," hand made, one with "S & F CO" indented rectangle on one face. Found on wreck site and toward bridge embankment. And lastly, a pile of iron pipes, some threaded with pipe unions, etc. (Muir 1981).

Regarding the hull remains, Muir wrote the following:

> The observed partial framing of the Boca Chica Channel Wreck includes oak (and some cedar) hull planking of 1 1/4" thickness, continuous oak (and some cedar) hull planking of 1 3/4" thickness (approx.), one possible oak strake or deck planking sample of 2 1/2" thickness, hand hewn oak futtock framing members of 3 1/2" varying to 4" widths by depth moulded of 4 1/4," spaced approximately 12" apart, all of carvel-type construction. The fasteners are all iron nails or spikes (widely varying shapes), and hewn oak treenails or 'trunnels' of 1" diameter (approx.) placed either alternating or random fastened through the planking and frame members. No brass or bronze fastenings of any kind were observed anywhere. Iron drift pins of approx. 1" diameter are numerous especially in the embankment area, but usage was not noted anywhere in the framework portions, hence was most likely used either in the keel to floor drift fastenings (keel not located), or in the deck to frame members at the hanging knees. I firmly suspect that there is deck framing higher in the embankment and buried out

> of sight behind the turtle grass and silt-sand slope, as the lead shot (0.63" diameter) rolled down from the embankment, and a great many of the drift pins were noted along the mid-slope of the embankment. The lead sheathing which you will see in package #3 is typical of the sheathing which appears randomly placed along the seam caulking, (not continuous by any means) and in some cases the lead was driven partially into the caulked seam, indicating that seams sometimes as much as 5/8" wide were being sheathed, obviously to prevent caulking from working out of the worn slots. The sheathing shows clearly the shape and head formations of the iron nails used to fasten it, but of course no iron nails survived. This compares favorably with the section drawing (lower right, figure 5, on p. 209) and the framing and planking sizes (p. 210) of the Lake Garda galley discovery described in *A History of Seafaring* by George Bass, editor. The side framing from the turn of the bilge to just below the gunwale is identical with the structure in Boca Chica Channel. Adding to this is the favorable possibility of artillery of the large sizes hinted at by the recovered shot, the similarity of the somewhat diamond shaped grapnel type anchor flukes on the recovered small boat anchor (presumed), and the explanation of just how the vessel got into the channel since the channel was, as indicated on an early 1920 chart of the area before dredging, somewhat inaccessible to deeper draft vessels because of a rock bar of approximately one fathom depth at MSL at the channel entrance (Muir 1981).

Muir considered that the wreck might be the remains of a late sixteenth- to early seventeenth-century vessel due to the presence of Spanish olive jars, the stone ballast, and several other artifacts. Due to the lightness of the hull's construction and small to medium vessel size, he considered the wreck to possibly be that of a galiot or bergantin of the late sixteenth century.

Sporadic diving continued on the site through the 1980s until the Navy restricted access (Muir 1981). When Muir surfaced on his last dive he reported that three Marine guards with rifles and fixed bayonets were standing on the beach opposite the wreck site. Two Navy boats were alongside his, and a Navy diver had entered the water to investigate Muir's activities. During the dive, Muir collected a small number of nineteenth-century bottles, which he had in his boat. A short time later, the Navy posted a sign on the beach restricting access and threatening violators with prosecution. Muir reported that before implementing the security zone, locals used the beach for picnics (Muir to Neyland August 6, 1997). In a letter to state archaeologist James J. Miller dated September

18, 1986, Captain R.F. Sullivan, commanding officer of NAS Key West, stated that certain restrictions would be placed on the site if it were located in the ordnance safety zone or the security zone. Sullivan was willing to allow archaeological work on the site as long as Navy regulations were followed. Authorization to excavate was granted to Captain William P. Frank, director of KWMHS (Sullivan 1986).

Concern over an admiralty salvage lien filed by Frank led Muir to hire Key West attorney Chip Muldoon. Based on Muir 's earlier work and the artifacts he had recovered, the court rejected Frank's claim. Shortly thereafter, the Navy, which had offered to assist Frank with excavation of the site, restricted entry and threatened to arrest anyone who attempted to visit the site. The officiating judge ordered a U.S. Marshall to place under court arrest a filing cabinet containing Muir's records. The cabinet remains in government custody. A court action filed by Frank on May 14, 1991 led Muir to file his own admiralty salvage claim. Muir stated that he feared the shipwreck would be exploited for commercial gain (Muir to Neyland 1998). Muir's claim was upheld in Case Number 86-0672, CIV-KEHOE.

The Navy established a security zone along the shoreline near ammunition storage bunkers and prohibited recreational diving in the area. The Navy security zone appears to have discouraged both visitors and organized efforts to salvage the site. However, future expeditions and investigations of the site continued to be discussed by Muir and other locals.

The NHC became aware of the site while developing a management partnership for U.S. Navy shipwrecks with the state of Florida. In 1995, the NHC partnered with FDHR to inventory, investigate, and prepare management plans for significant Navy shipwrecks in Florida waters. During the course of this work, Dr. Roger C. Smith, Florida's state underwater archaeologist, expressed his concern about the preservation of the Boca Chica Channel Wreck. Smith requested that the NHC investigate and, if necessary, take action to preserve the wreck. Furthermore, the Florida State Historic Preservation Officer (FSHPO) recommended that the Boca Chica Channel Wreck be included in the Florida Historic and Archaeological Resource Protection (HARP) Plan and evaluated for inclusion on the National Register of Historic Places (NRHP).

At the same time, local interest was renewed, accompanied by requests to dive on the site. Dr. Robert Neyland of the NHC's Underwater Archaeology Branch contacted the Navy's Federal Preservation Officer, J. Bernard Murphy, requesting assistance. Murphy contacted Richard Davis, NAS Key West's cultural resources manager to request that diving be prohibited on this site, and recommended that the station coordinate with the NHC to schedule a professional archaeological survey.

At Neyland's request, Whall and Silvia relocated the wreck. With the use of a Global Positioning System (GPS), they identified its coordinates. While surveying the site, they observed the presence of ballast stone, hull timbers, and what appeared to be eighteenth-century artifacts intermingled with intrusive nineteenth- and twentieth-century material.

Phase I and II Investigations 1997

After the site was relocated, Phase I and Phase II investigations were planned with the following objectives: assess the site's eligibility for listing on the NRHP; assess primary threats to the wreck's integrity; and make informed management recommendations. A combined remote sensing and diving survey of the shipwreck was organized as a multi-agency partnership among the FDHR, FKNMS, NPS-SRC, NAS Key West, and the NHC.

Site Description

The Boca Chica Channel Wreck site consists of a low mound of ballast stones (including water-worn pebbles and cobbles and some quarried rock) in a contiguous deposit at the bottom of the channel slope and a surface scatter of artifacts (including glass bottles, ceramic fragments, iron fittings, etc.). Many items within the site's boundaries are obviously modern and intrusive. There is evidence of prior site disturbance. Ballast stones appear to have been overturned and scattered, and some areas exhibit evidence of excavation. This is not surprising given Muir's admitted activities at the site during the 1980s. A length of dredge hose lying on the site suggests that there could have been more significant and destructive visits by divers prior to the 1997 investigations.

Research Design

The site exhibits local, state, and national significance and is considered to be potentially eligible for listing on the NRHP. Muir's initial evidence presented suggested that the shipwreck might be the earliest historic site in the Florida Keys. It also represents the only intact shallow-water shipwreck site from the early historic period currently known to exist in the Florida Keys.

The survey consisted of two components. The first was a multi-component remote sensing survey with marine magnetometer, side-scan sonar, and GPS. SRC provided the marine magnetometer and DGPS receiver equipment, conducted the survey, and analyzed the data. FKNMS provided the survey boat and fuel. In addition to the primary survey area of 8MO1448, all submerged Navy property accessible to the survey boat was included in the remote sensing operations. The remote-sensing project was completed in two days.

The second phase comprised preparation of a detailed site plan, archaeological test excavation of a portion of the site, and recovery of exposed artifacts. Remote-sensing survey data, site mapping, and site conditions determined the test excavation's location and size. Excavation units did not exceed 20 feet in length and four feet in width. Excavation was conducted principally by hand fanning, but a small water-induction dredge was used when sediment could not be adequately removed by hand. Archaeological survey work was limited to two windows of opportunity of one hour each in the morning and evening, due to strong tidal currents. The divers backfilled the excavation area to its original condition after completion of the project.

The goals of the archaeological survey included the following:

- test GPS coordinates and establish UTM coordinates for the site;
- determine the wreck's state of preservation and archaeological integrity;
- delineate the site's boundaries;
- document the site with a combination of a drafted site plan, photographic imagery, and if possible, a photo-mosaic and video;
- determine the date of wrecking, nationality, and ship type;
- conduct personal interviews with locals to determine the amount of previous site disturbance;
- recover and curate artifacts previously removed from the site and;
- develop site management proposals for NAS Key West.

Chapter Four Remote Sensing Survey and Methodology

Pre-disturbance Remote Sensing Survey

During the summer of 1997, the NHC requested the assistance of NPS-SRC in conducting a pre-disturbance remote sensing survey in the area surrounding a possible early colonial shipwreck site in waters administered by NAS Key West. Because SRC was completing a System-wide Archaeological Inventory Project (SAIP) survey at nearby Dry Tortugas National Park, deploying their remote sensing survey system could be accomplished easily and with minimal cost.

Survey Objectives

Before beginning test excavations, a pre-disturbance remote sensing survey was conducted over an area that included the wreck's remains and Boca Chica Channel. Systematic hydrographic remote sensing was utilized for magnetic reconnaissance to provide a synoptic overview of known and potential cultural remains and relationships within the study area. In addition, while the survey instrumentation was deployed, the Navy requested that SRC complete magnetometer coverage of the remaining NAS Key West's bottomlands. Initial reconnaissance determined that only the marked channels could be surveyed; all other areas were too shallow for the survey vessel. Finally, NOAA requested that a block offshore Boca Chica Channel, reportedly containing cultural remains within the FKNMS, also be surveyed.

The survey located additional cultural material and site-related features useful for planning test excavation and aiding site interpretation. Developing a remote sensing-derived view of the site prior to test excavation was important for planning to ensure related features near the principal site were identified and investigated. Location of outlying ferrous masses possibly associated with the principal target site was a primary objective. Secondary objectives were to inventory submerged cultural resources on Navy bottomlands accessible to the survey boat, and complete magnetometer coverage of the specified offshore block for NOAA.

Survey Design and Rationale

The survey was designed to produce a comprehensive data set that would be immediately accessible for planning and interpretation during the test excavation. Data collection, post-plotting, analysis, and presentation were designed to be utilized in a GIS database for use during the project and incorporation into permanent state and Federal archives.

This approach produces an electronic product that can combine existing data, such as aerial imagery and historical maps, so data can be included with project-specific results and be analytically manipulated to examine relationships that would otherwise be extremely difficult. The project GIS data set was generated to provide a standardized, permanent, cumulative, computer-accessible product for multiple applications for project researchers, managers, and those involved in planning and conducting future site operations.

Geographic Information Systems (GIS)

GIS uses various spatially-referenced databases to produce maps that graphically depict combinations of variables presented as themes, layers, or coverage. Spatially referenced data are basic to archaeological inquiry, but it has only been in the last few years that technological advances in software and hardware have overcome difficulties in collecting, collating, storing, editing, querying, depicting, and manipulating the large amount of data generated by a marine remote sensing survey. Results of the Boca Chica Channel Wreck survey were formulated to be incorporated into a GIS operation in the field and easily transferable to state and Federal managers.

GIS systems provide a methodology to compare variables among many sets of spatial data, such as artifact categories and natural environmental characterizations, to examine distribution and change over space, and, if sufficient data are available, over time. Manipulation of scale can allow pattern recognition that may not be apparent at other levels. Results of examinations of combined variables are instant because they are presented graphically, greatly simplifying analysis by precluding the necessity of generating mathematical and statistical models to characterize patterned relationships. Current computer and software speed allow rapid manipulation of multiple variable combinations, which allow generation of associations and relationships that might otherwise be unanticipated. Hypotheses can be quickly generated and tested through seamless graphical display. Data manipulation can easily be done by researchers or managers with basic GIS software familiarity, which does not require sophisticated mathematical ability.

GIS data sets can be presented as tabular database files or themes that can be generated, analyzed, scaled, combined, superimposed, and displayed through direct user access in unlimited variations. Data themes are presentations of nonspatial data referenced to a common location expressed as geographic coordinates. One way of looking at themes is to consider them as x-y horizontal locations that share a category of variable z values, which represent discrete, quantifiable attributes. Analytical techniques include statistical and spatial analysis, measurement, and comparisons that can be used to create additional themes reflecting analytical results.

GIS can be contrasted with computer-assisted design (CAD) systems that are generally limited to graphic output such as drawings, pictures, and maps and contain no relational database capability nor the ability to generate new data sets based upon analytic functions. CAD systems generally contain no interrogative capability and are unable to manipulate non-spatial database attributes.

Two problems make creation of GIS data sets expensive and time consuming: accuracy determination and conversion of various data sets to an appropriate format. Mixing different levels of accuracy among data sets degrades overall GIS accuracy and gives a false sense of comparability that can lead to serious analytical problems in data interpretation. Data set conversions must consider fundamental geodetic concepts such as geoid, ellipsoid, datum, coordinate system and projection. Geodesy factors vary over time and space, and each variation is critical to conversion accuracy. Few archaeologists record a chart's datum and projection when generating coordinates. For example, latitude/longitude coordinates in datum NAD27 and those in World Geodetic System (WGS) 1984 can vary from tens to hundreds of meters; confusing these datum positions introduces serious error. Being given coordinates in NAD27 and trying to relocate the point with an instrument reading in WGS 1984 is an easy and common mistake. All data generated during the Boca Chica Channel Wreck Project was based on the WGS 1984 datum.

Although the survey was designed to ultimately produce GIS database products, the use of GIS for on-site, field manipulation and evaluation of raw field data for immediate reoccupation and groundtruthing was helpful to the Boca Chica Channel Wreck test excavation operations. The survey phase had to provide for immediate and easy utilization of large volumes of field data, develop topographic context of survey blocks, and allow investigators to post-process, manipulate, evaluate, and assimilate the field data on a daily basis. Ideally, GIS evaluation would be the basis for establishing test excavation sequence and extent, which are based on analysis of the accumulating data set (Murphy and Smith 1995:26-33).

GIS Data Archiving

Raw field data archiving is as much a concern as any archaeological data archiving, and it must be planned in advance. The Boca Chica Channel Wreck survey electronic data archiving is in a non-proprietary format, primarily DOS ASCII text, which ensures long-term data accessibility by many scientific disciplines, managers, archaeologists, and other researchers. All results are stored in latitude/longitude and Universal Transverse Mercator (UTM), WGS 1984. SRC stores archive data in latitude/longitude coordinates so that the database can be easily converted if future alterations or corrections are made to WGS 1984; it is more diffi-

cult to convert grid coordinates. Grid coordinates are necessary for computer utilization. Upon project completion, the appropriate state and Federal managers were provided a CD-ROM containing all pertinent field data and GIS coverage. This CD-ROM is directly accessibly through ArcView, a readily available GIS program.

Survey Blocks and Sample Intervals

Hydrographic survey is conducted in area blocks through which the survey vessel travels along pre-plotted transects or lanes, at proscribed intervals designed to ensure complete instrumental coverage of the area. Lane spacing depends on the nature of the survey questions and attributes of remote sensing instruments deployed. The Boca Chica Channel Wreck survey was conducted with a number of pre-plotted blocks to maximize remote sensing coverage. Standard SRC practice is to label survey blocks with a four-letter acronym (in this case BOCH - Boca Chica) followed by a numerical designation.

The NHC provided the coordinates for the Boca Chica Channel Wreck's remains. The initial survey block (designated BOCH001) was constructed with 5-meter transects within the Boca Chica Channel, between channel markers G "1B" and R "8" to the north, and G "7" and R "6" to the south. Standard SRC survey methodology for wide area survey requires 30-meter transects, which have been demonstrated to provide cost-effective magnetic coverage for most historical site survey (Murphy 1984:90-95). In this case however, precise locations of the vessels were known; the purpose of the magnetometry was to locate smaller, associated materials. Five-meter lane spacing was selected as the sample interval for the intra-site magnetic survey, which should be sufficient to locate small ferrous materials and environmental features. Coverage for the remaining channel areas within NAS Key West's jurisdiction (designated Channels A, B, and C) were not pre-plotted because of channel width; visual transects were instead employed to ensure complete coverage. Transects for the block offshore in NOAA's waters (designated BOCH002) were run on pre-plotted 30-meter lane spacing (Figure 4).

GPS provides a position every second, and instrument data are collected at less than two-second intervals and collated with the appropriate DGPS position. At a typical boat speed of six knots, a sample is collected about every four to six meters along the transect.

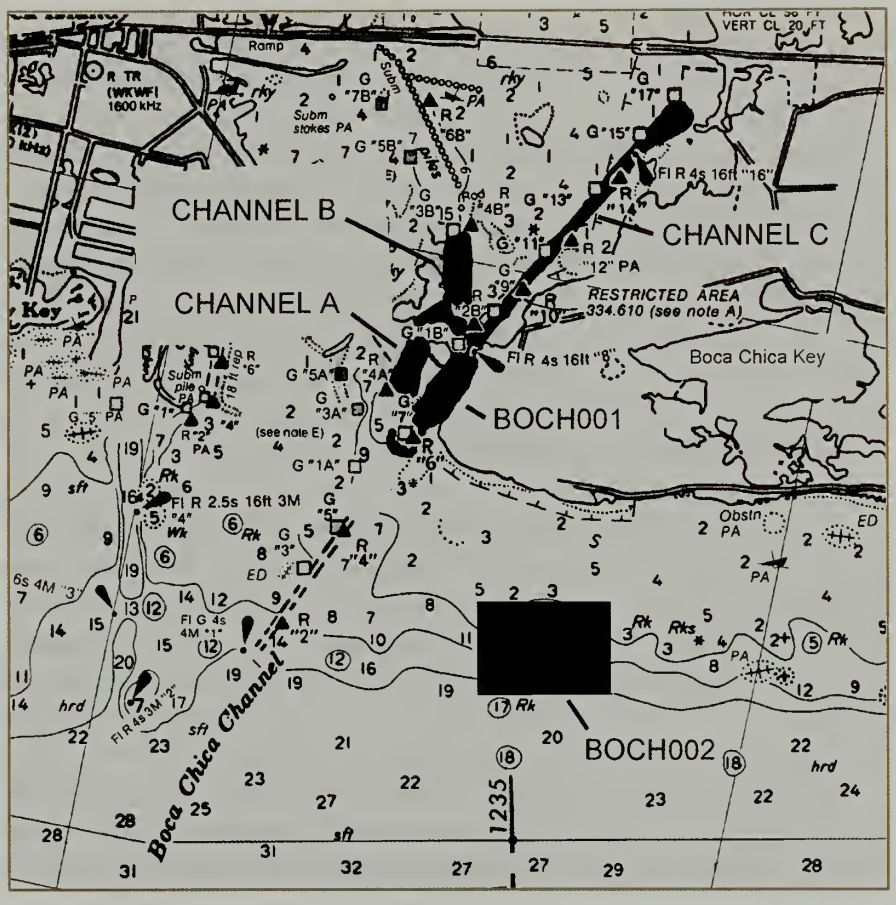


Figure 4 • Transects for the block offshore in NOAA's waters (designated BOCH002) were run on pre-plotted 30-meter lane spacing.

Positioning

Hydrographic survey demands real-time positions with very rapid updates (1-2 seconds) for accurate vessel navigation to ensure complete, systematic coverage at the required sample interval. Accuracy requirements for GIS applications are a 2-3 meter circle-of-error or less. Unlike terrestrial mapping, hydrographic mapping has no landmarks; simply, it is very difficult to occupy and then reoccupy the same point and to continually know where you are.

Accuracy is usually expressed as parts per units (e.g. 1:10000), plottable accuracy; or circle of error, which is an ellipse whose largest radius represents the root mean square error of a set of measurements, and whose orientation shows directional uncertainty. The ellipse, centered on the true position, is typically at the 95% statistical confidence level. The least squares method is becoming standard for positional accuracy determination.

Although several positioning systems are presently available, GPS offers advantages over others. GPS has become the state-of-the-art and will likely replace other systems for most applications. The U.S. Department of Defense (DOD) developed the GPS system for military purposes. This system uses trilateration of satellite-transmitted signals to determine position. GPS provides one-second updates with global coverage from 21 satellites, meaning four or more space vehicles are continuously in view. The satellites produce two signals, known as C/A code and P code frequency, the latter encrypted and available only to military users. The GPS is close to an ideal positioning system; it is accurate and continuously available on demand anywhere in the world under any weather conditions.

The combination of GPS and GIS has provided a solution for accurate positioning and analysis; however, some additions to the basic GPS system are necessary to achieve acceptable accuracy levels. Autonomous civilian GPS receivers produce circles of error of about 10-30 meters. This GPS instrumental accuracy is further reduced by "selective availability" (SA), which is intentional dithering of the C/A code GPS signals by DOD that degrades the signal to an accuracy of 100 meters. However, real-time accuracy of two to three meters is possible when using a base station to correct for SA and ionospheric propagation variables through differential GPS (DGPS) correction. The base station set up on a control point whose position is known to a very high level of accuracy generates corrections and transmits them to the mobile survey instrument. Broadcast differential corrections are currently available in most coastal areas though the U.S. Coast Guard navigational beacons and commercial suppliers provide differential corrections at various accuracy levels. For example, the Coast Guard navigation beacons used during this project are guaranteed to a 10-meter circle of error, though use during SRC surveys has demonstrated a four-meter or less circle of error (Shope, Murphy, and Smith 1995:22-34).

Survey Instrumentation

SRC's GPS-based Archaeological Data Acquisition Platform (ADAP) survey system, designed and built by Sandia Research Associates, Inc. of Albuquerque, New Mexico, to SRC specifications, was used during the remote sensing phase of the Boca Chica Channel Wreck. The ADAP system automates and integrates field data collected with a variety of remote sensing instruments, and accurately tags each data point with real-time differential GPS position and time references. Data points were collected every 1.5 seconds or less for the duration of the entire survey. Generating survey blocks, navigating the pre-plotted lanes, and collecting and post-processing data were done with Coastal Oceanographic's "Hypack" hydrographic survey software. The data was then easily incorporated into a PC-based GIS, in this case using ESRI's ArcView.

Positioning System

Positioning accuracy was consistently within a four-meter circle of error throughout the survey area. A Trimble Navigation Accutime II GPS receiver and NavBeaconXL differential GPS beacon receiver were used onboard the survey boat for positioning survey navigation and data collection.

Magnetometer

The principal cultural resource detection device used in the Boca Chica Channel Wreck survey was a proton-precession magnetometer. A Geometrics of Sunnyvale, California, model G-876 proton-precession magnetometer was used as part of SRC's ADAP system. The magnetometer is sensitive to ferrous or magnetic objects, typically of cultural origin associated with maritime casualty sites. The magnetometer output is proportional to the total magnetic field intensity and independent of the orientation of the sensor coil.

Typical accuracy is one gamma, and in special cases 0.1 gamma, in the earth's field of approximately 50,000 gammas (nanoteslas). Magnetic readings simply indicate the presence and probable size of an object; there is no unique relationship between anomaly intensity and configuration and object. Any number of combinations of objects can produce similar anomalies. The only way of determining anomaly sources is by visual investigation.

The magnetometer is a valuable detection system and is sensitive to many different types of artifacts associated with submerged shipwrecks. Ferrous metal ship components are prime targets. In a reconnaissance mode, shipwrecks are often difficult to detect by visual inspection or sonar because marine life encrustation and sediment coverings can easily obscure a site. The magnetometer sensor and magnetometer depth transducer are towed 20-40 meters behind the survey vessel to eliminate influence from the survey vessel's magnetic field.

The G-876 instrument generates a sensor depth and height over bottom (sensor altitude) and displays these data during the survey. Sensor height is important for consistent and reproducible magnetic data collection and interpretation.

Another feature of the G-876 important for the marine survey is that the computer processing data sensor is towed underwater 10 meters ahead of the instrument sensor. This instrument, designed for deep-water survey, produces a remarkably low noise level because only data and power are transmitted over the tow cable. Magnetometers of traditional design have

the computer on the surface and transmit the raw signal from the sensor to the surface, which creates a much higher noise level because the cable acts like an efficient antenna for extraneous noise-producing electrical energy.

The industry standard (for example, Department of Interior, Minerals Management Service Guidelines for Offshore Lease Block Surveys) specifies a proton-precession noise level of +/- 3 gamma or less. The G-876 typically produces less than one gamma of noise, which allows smaller anomalies to be accurately observed. Reliable contouring for traditional magnetometers is rarely done on fewer than five gamma contours; the G-876 allows reliable contouring on two gamma. The G-876 permits discrimination and recognition of anomalies that are within the noise levels of most other magnetometers. Because the Boca Chica Channel Wreck survey was attempting to locate undiscovered materials associated with the primary site, discrimination of the smallest possible magnetic anomalies was desirable.

Hardware

Austin 486DX2/66 PC laptops were used for field data collection and manipulation, and a Comtrade Pentium 166 PC workstation for office data manipulation and generation of GIS coverage. Trimble Navigation's Accutime II was used for positioning during survey operations. Trimble Navigation's NavBeaconXL differential GPS beacon receiver was used for real-time differential corrections. Geometrics G-876 proton precession magnetometer was the primary instrument used during surveying operations. A Rockwell P-code Precision Lightweight GPS Receiver (PLGR) was used to take points to define the survey area, as well as record the positions of the primary site datum.

Software

SRC selected several off-the-shelf, PC-based software programs: AutoCAD by Autodesk (Sausalito, California); QuickSurf by Schrieber Instruments (Denver, Colorado); Hypack hydrographic data collection software by Coastal Oceanographics, Inc. (Durham, Connecticut); and ArcView, a geographical information system by ESRI, Inc. (Redlands, California). All are PC-based and provided quick and easy access to field data in a MS-DOS/Windows environment.

Survey Methodology

Initial survey preparation took place in Key West prior to the project. Because digitized charts of the area normally used to plan survey blocks were not available, a number of GPS points were collected along the channel edges to define the survey area. Survey blocks were constructed in desired areas, and computer software was used to generate survey

lanes with beginning and ending X-Y coordinates at appropriate transect intervals. Magnetic lanes within the Boca Chica Channel were pre-plotted at five-meter intervals, while offshore lanes were pre-plotted at 30-meter intervals.

General methodology included DGPS positioned survey with a marine magnetometer, with differential corrections provided by the U.S. Coast Guard differential beacon in Key West. Because of the proximity of the Coast Guard beacon to the survey area, uninterrupted contact with the beacon was maintained for the survey's duration.

High-resolution magnetic survey was directed toward locating ferrous material possibly related to the Boca Chica Channel Wreck. In addition, magnetic coverage of the remaining U.S. Navy bottomlands and the offshore block under NOAA jurisdiction was planned as a preliminary inventory of submerged cultural resources.

Survey data was post-processed and immediately incorporated into a PC-based GIS program that contained all related data. This cumulative data set was used to plan the test excavation phase and will provide a baseline for future site examination.

Survey Operations

Constant DGPS positioning was employed in all survey operations for an overall accuracy of a four-meter or less circle of error throughout the survey area. Pre-plotted survey lanes were followed using navigation information provided by the DGPS and displayed in Hypack. A computer monitor mounted near the helm provided the boat pilot with current position as well as navigation information such as cross-track error, speed, course, distance to end-of-line, and bearing to end-of-line. In addition to tabular information, a graphical display showed real-time boat position, movement, and survey lanes.

Data was saved to the hard drive of an onboard computer as it was collected. Data collection was continuous; no buoys were used to mark anomalies. Data were backed-up nightly to an external Iomega Zip drive and processed in the field.

Survey operations began September 2, 1997. The NOAA survey vessel R/V *Captain Utting*, equipped with the ADAP system, moved into the primary survey area, the Boca Chica Channel, and began collecting data. The survey block (BOCH001) contained twenty 750-meter long lanes five meters apart, oriented northeast/southwest. The survey block was created to fill the Boca Chica Channel to ensure complete coverage. Because the channel is curved with irregular shorelines, following the pre-plotted lanes proved impossible. Instead, the boat pilot used the real-time boat

position displayed in Hypack and attempted to visually maintain the five-meter lane spacing through the curving channel. Because of this, strict five-meter lane spacing was not maintained, though the resulting density of coverage more than adequately covered the survey area. Magnetometer coverage of the primary survey area, BOCH001 (Figure 5), was completed on the afternoon of September 2. The data was processed that evening to ensure full coverage.

Survey operations continued on September 3. The offshore block, BOCH002 (Figure 6), was constructed with eighteen 30-meter wide transects covering a 650 meter by 450 meter area indicated by NOAA. This block was completed following the pre-plotted lanes. After completing block BOCH002, the three main channels running through NAS Key West's waters were run with complete magnetometer coverage. These channels were designated Channel A, in the southwest corner of Navy waters, between channel markers G "1B" to the north and R "4A" to the south; Channel B, along the western edge of Navy waters, between channel markers G "3B" and R "4B" to the north and R "2B" to the south; and Channel C, the northern part of the main Boca Chica Channel, between G "15" to the north and R "8" to the south. The survey vessel made two to four runs up and down each channel, which provided complete coverage on less than 30-meter spacing. Survey operations ended September 3, and SRC's ADAP system was removed from R/V *Captain Utting*. That evening, the data was processed and analyzed.

The magnetometer was towed just below the water surface for the entire survey. Because water depth never exceeded 6.1 meters, this resulted in a constant instrument height over bottom of six meters or less.

Analysis and Results

Magnetometer coverage in all survey areas was comprehensive and complete. Coverage in the primary survey area, BOCH001, averaged 5-meter lane spacing and resulted in more than 1,700 sample points. Lane spacing in survey block BOCH002 adhered to strict 30-meter pre-plotted lanes and resulted in more than 2,200 sample points. Magnetometer coverage of the channels averaged lane spacing less than 30 meters and more than 1,000 sample points were recorded (Figures 7, 8, and 9). Because of the high concentration of intrusive ferrous material in the primary survey area, the magnetometer data was contoured on 10 gamma using a horizontal gradient calculation. This method eliminates diurnal changes and facilitates incorporation of magnetic data into GIS. Anomalies greater than 10 gamma were labeled numerically within each survey area; for example the first anomaly in survey block BOCH001 was labeled BOCH001-001. According to the model for submerged historical site survey developed by Murphy (1984:85-140), at 30-meter lane spacing all 10 gamma anomalies potentially represent colonial period shipwreck sites.

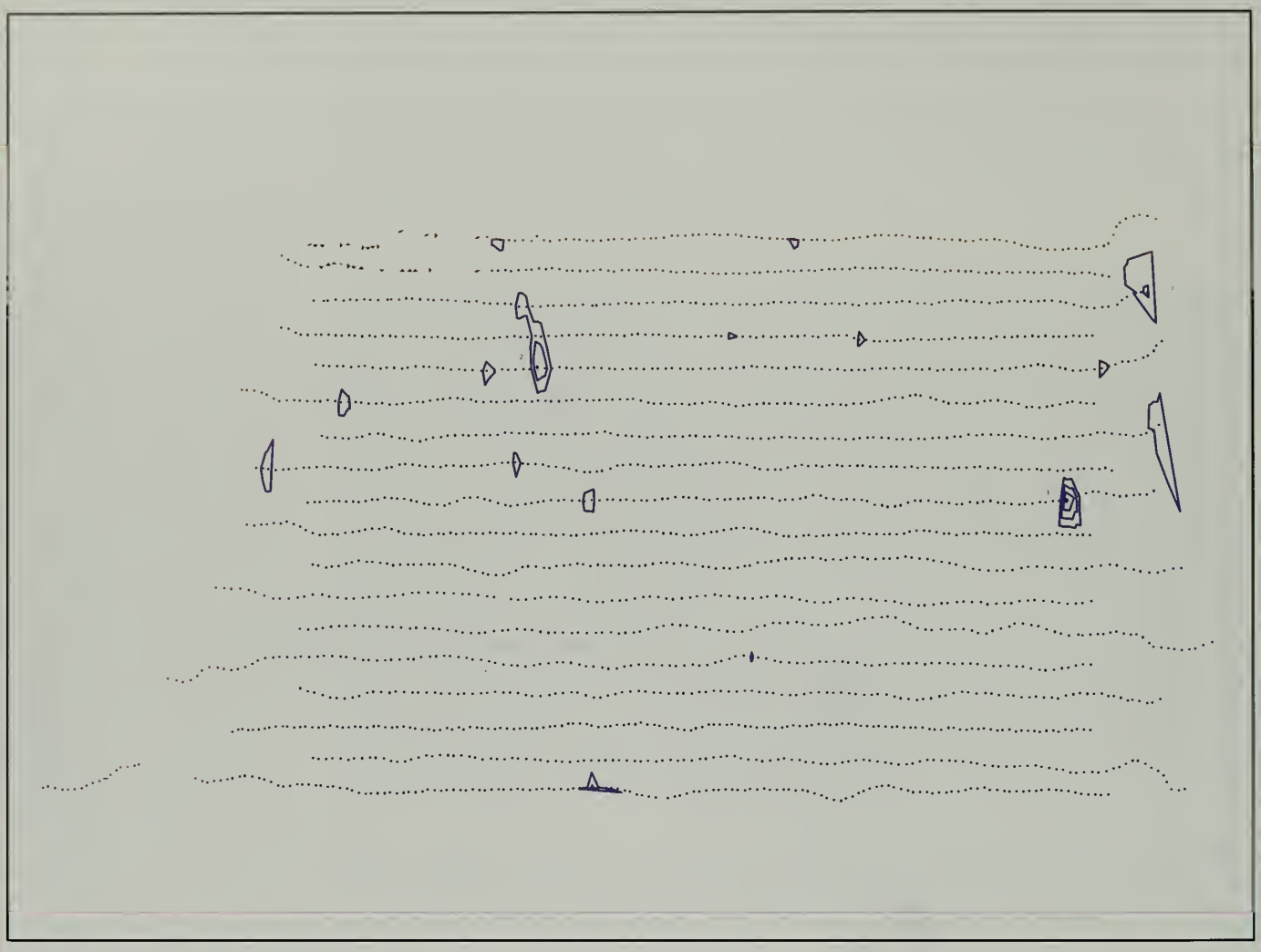
BOCH001 10 Gamma Magnetic Contours
BOCH001 Survey Data Collection Points (Tracklines)

200 0 200 Meters

N

National Park Service
Submerged Resources Center

Figure 5



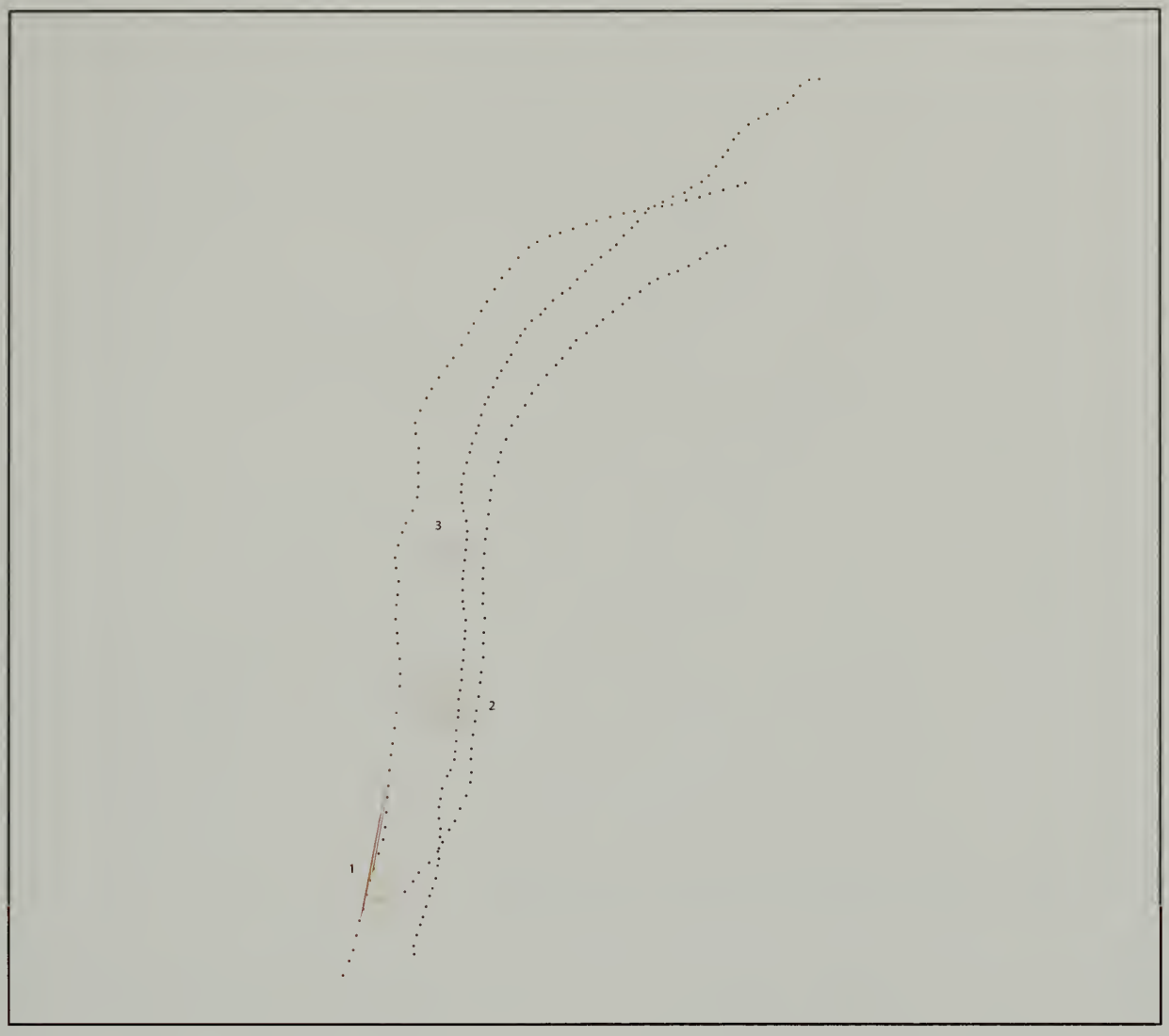
BOCH002 10 Gamma Magnetic Contours
BOCH002 Survey Data Collection Points (Tracklines)

200 0 200 400 Meters

N

National Park Service
Submerged Resources Center

Figure 6



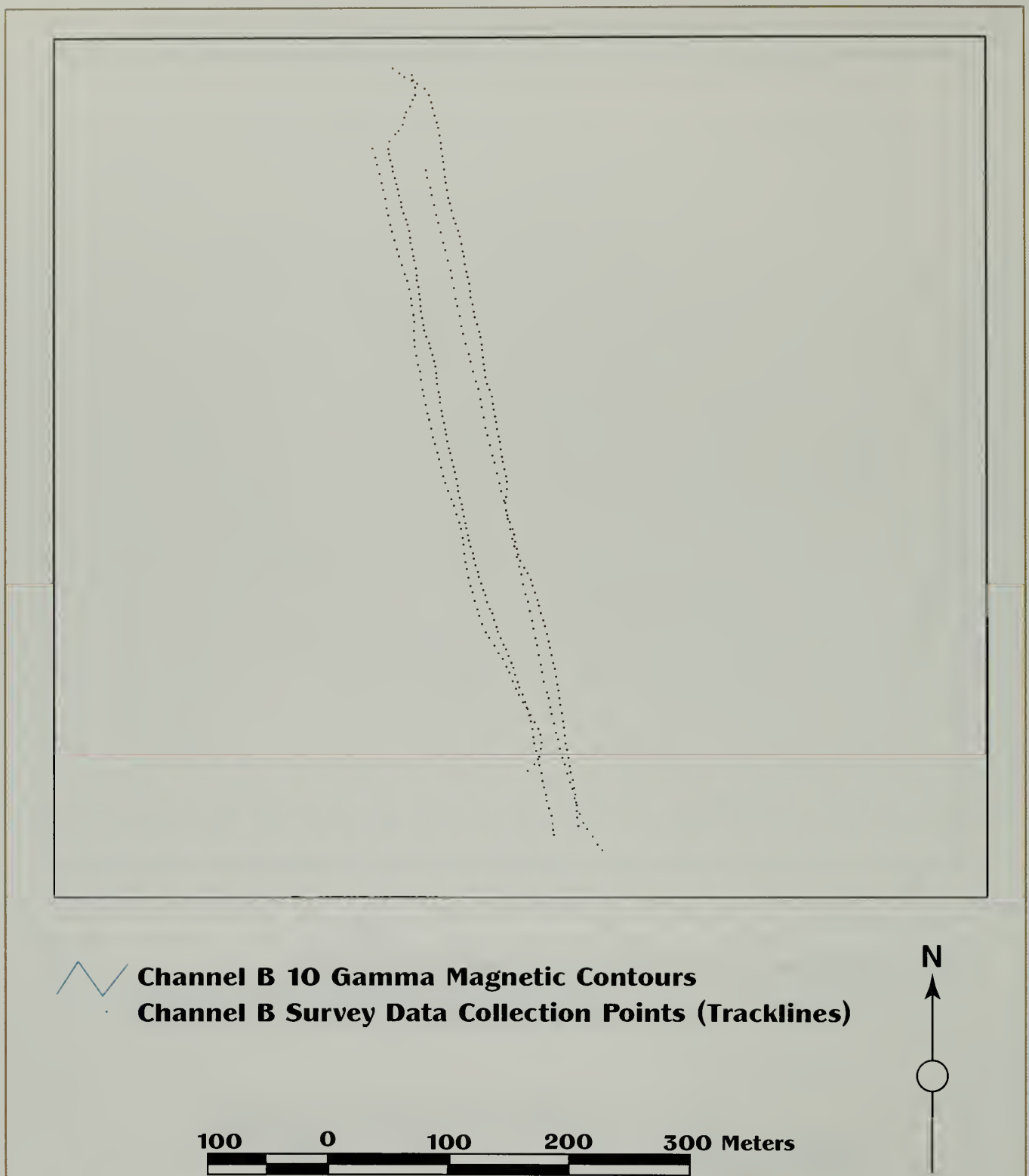
Channel A 10 Gamma Magnetic Contours
Channel A Survey Data Collection Points (Tracklines)

N

90 0 90 180 270 Meters

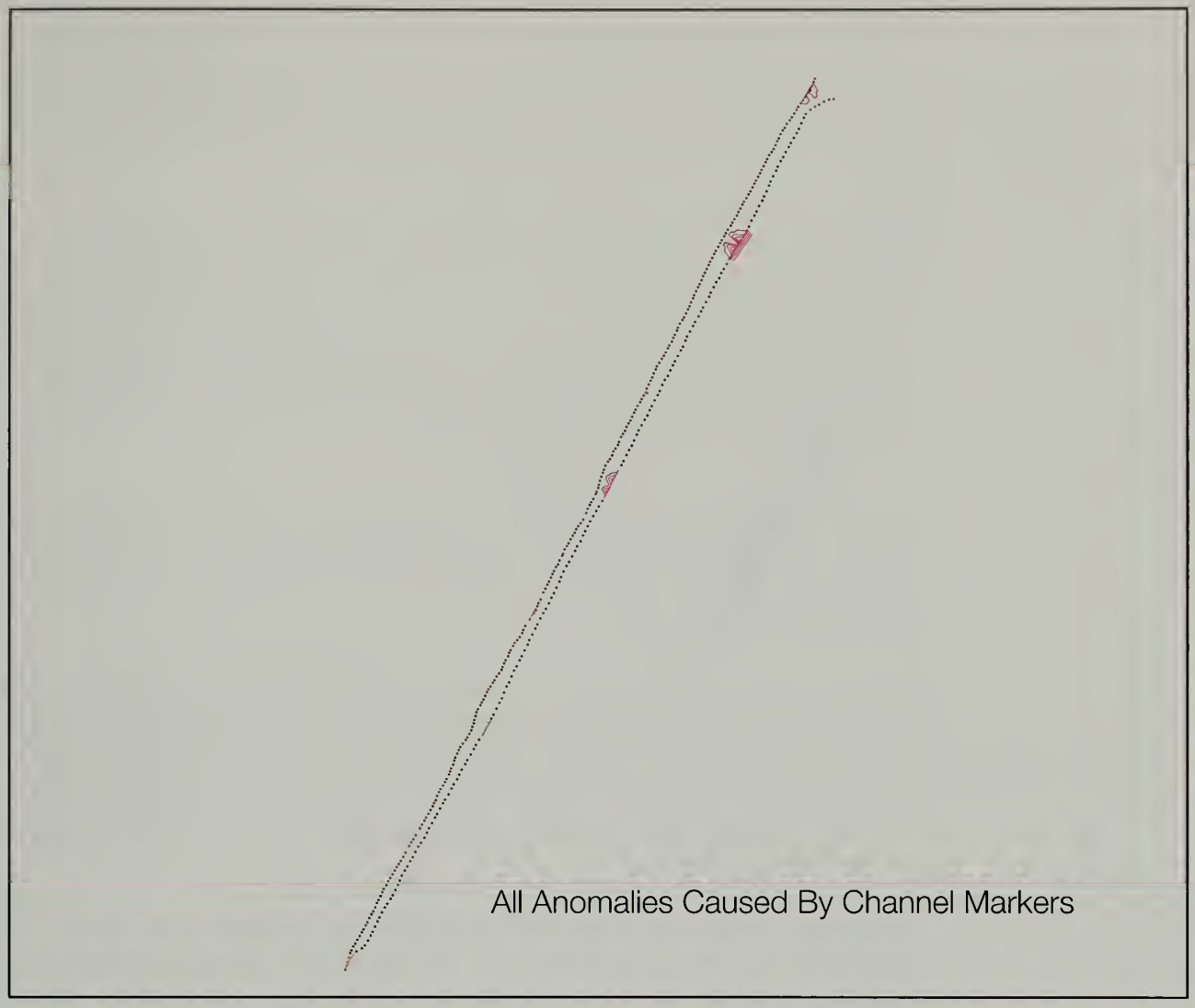
National Park Service
Submerged Resources Center

Figure 7



National Park Service
Submerged Resources Center

Figure 8



Channel C 10 Gamma Magnetic Contours
Channel C Survey Data Collection Points (Tracklines)

N

400 0 400 800 Meters

National Park Service
Submerged Resources Center

Figure 9

Because BOCH001 was covered at greater resolution, 10-gamma anomalies are probably smaller objects, but should be examined visually due to potential association with the study site. For block BOCH002 and the channels, all 10-gamma or greater anomalies could represent shipwreck sites and should be visually ground-truthed.

Compared to the surrounding area, the Boca Chica Channel Wreck (8MO1448) generated a low-level magnetic anomaly of approximately 20 gammas (Figure 10). Several larger anomalies surrounding the wreck site should be examined first during anomaly investigation. These include BOCH001-001, 002, 003, and 008. The largest anomalies encountered during the survey represent channel markers and a reinforced concrete overhead power cable tower (Figure 11).

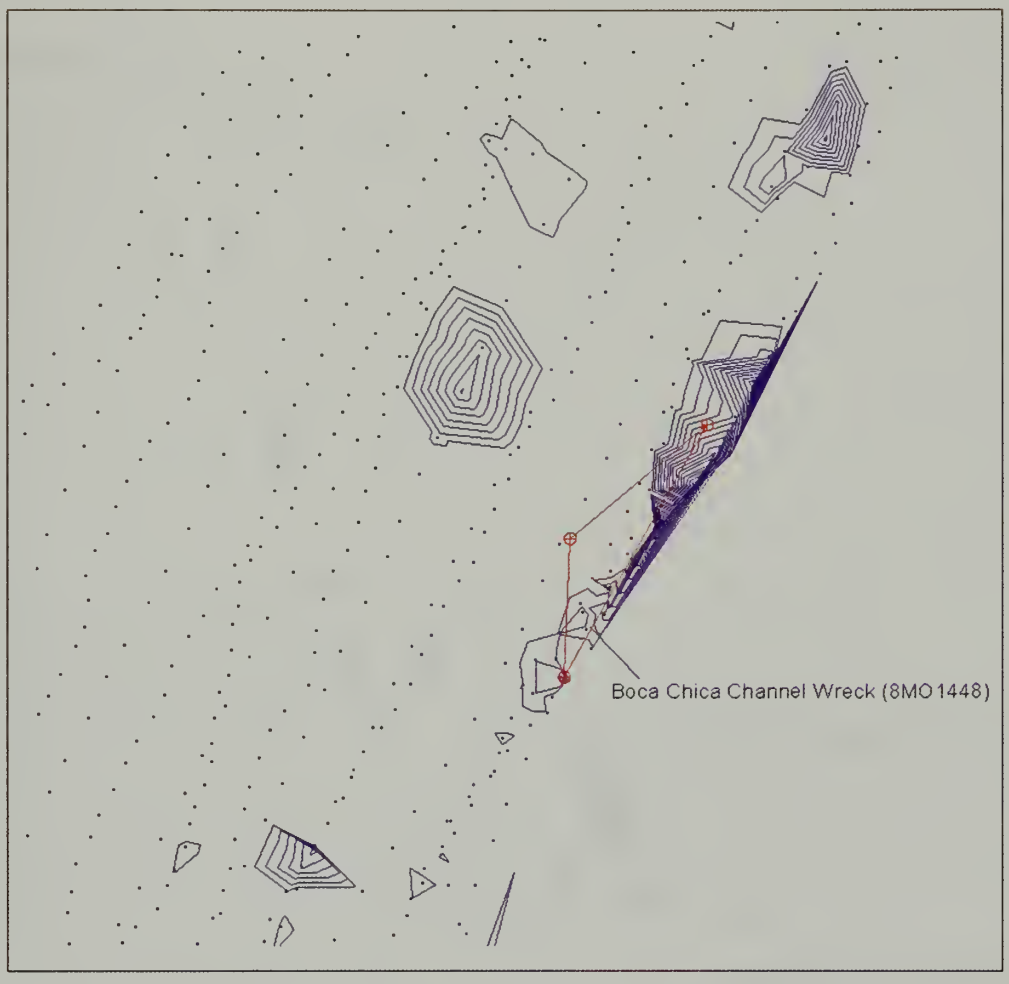
Survey block BOCH002 is relatively magnetically quiet. Three anomalies greater than 10 gammas were numbered and should be the priority for investigation. The remaining 10-gamma anomalies should also be visually examined (Figure 12).

Sailboats moored in Channel A made survey difficult and also generated large anomalies. All anomalies in Channel A were caused by these sailboats. The presence of boats, with their associated large magnetic signatures, could mask other cultural material on the seabed. Each of these anomalies should therefore be examined visually, but should not be seen as priorities (Figure 13).

Only three 10-gamma anomalies were recorded in Channel B. Each should be visually ground-truthed. The Channel C survey resulted in a localized anomaly around each channel marker and nothing else. The dredging of this channel would have impacted any cultural remains in the area.

The Boca Chica Channel Wreck pre-disturbance remote sensing survey resulted in complete magnetic coverage surrounding a possible early colonial-period shipwreck site. Analysis of the magnetometer data revealed many anomalies that could represent objects associated with the wreck. In addition, baseline magnetometer survey of other select areas was accomplished. All anomalies should be visually ground-truthed to determine the source of the magnetic signature.

This interagency project resulted in a cumulative data set accessible through PC-based GIS, to which future remote sensing data can be seamlessly added. Copies of this report and accompanying CD-ROM (including the ArcView GIS database and archived raw and processed survey data) were distributed to the NHC, SCRAP, and FKNMS. In addition, it is standard NPS-SRC practice to retain a copy of the report, GIS database, and survey data at the SRC office in Santa Fe, New Mexico.



1997 Baseline

BOCHO01 10 Gamma Magnetic Contours

BOCHO01 Survey Data Collection Points (Tracklines)

20 0 20 40 Meters

N

National Park Service
Submerged Resources Center

Figure 10

Figure 11 • Anomalies generated from channel markers and power cable tower.

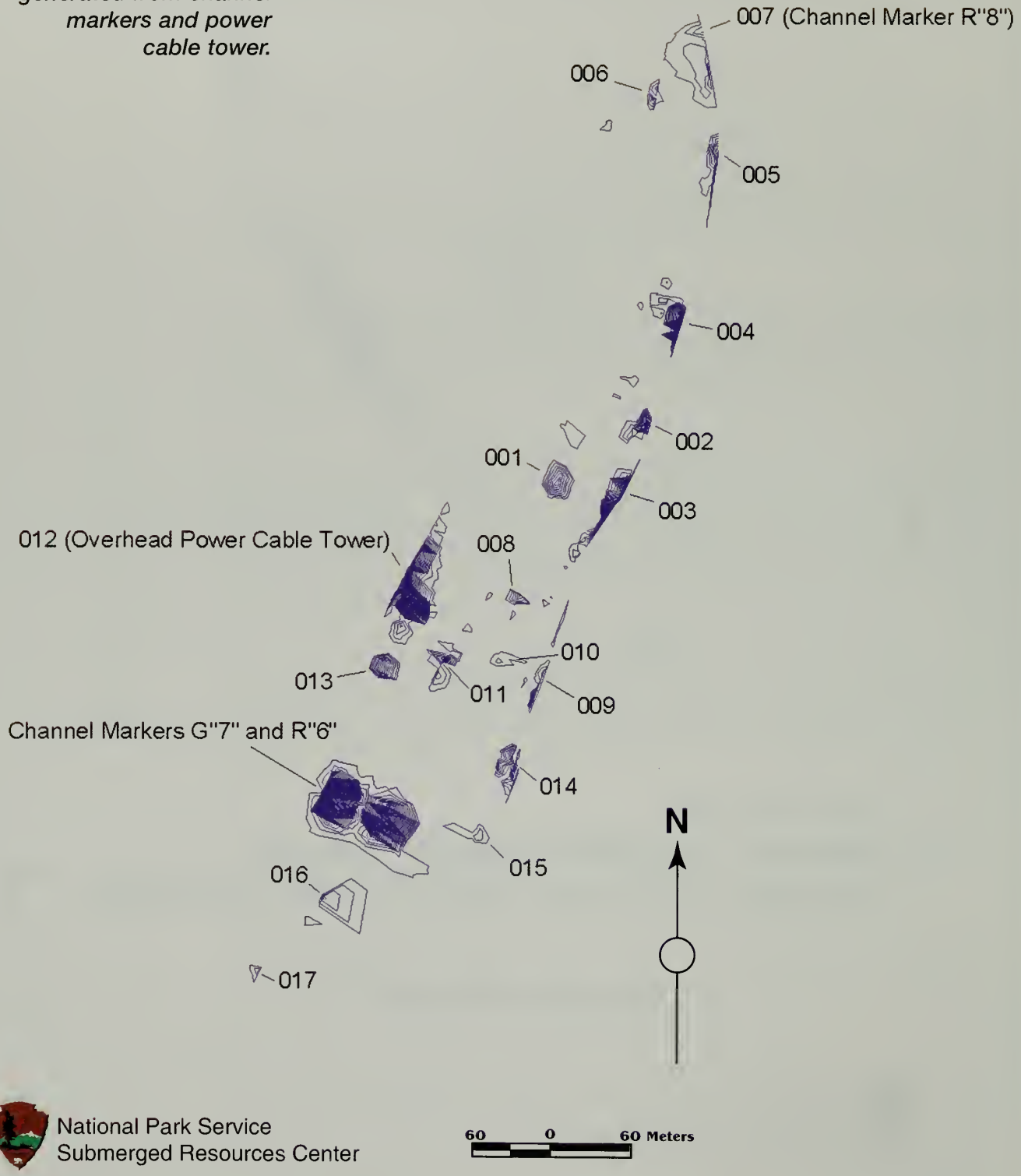


Figure 12 • Anomalies in survey block BOCH002.

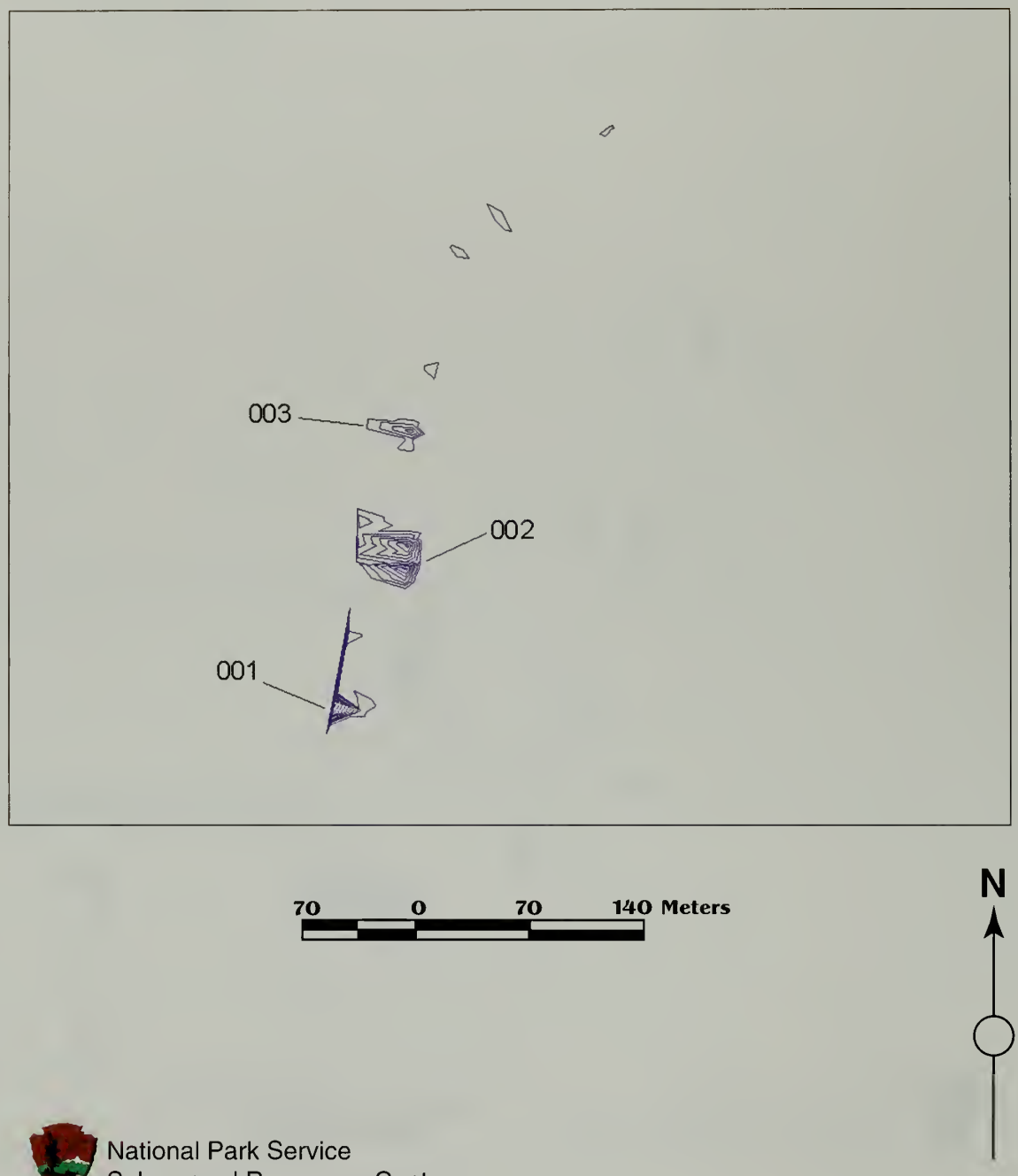


Figure 13 • Anomalies in Channel A.

Robert Neyland holds sandglass discovered at the wreck site.

Chapter Five Archaeological Methodology

The second component of the site investigation consisted of detailed mapping and Phase II archaeological testing of a portion of the site. This involved recording the site with video and still photography, establishing a permanent datum for site mapping, preparing measured drawings with tapes, and conducting a test excavation. The location of the site datum was determined using a Precision Lightweight GPS Receiver (PLGR), which used a P-coded signal. The PLGR has an accuracy of a four-meter circle of error.

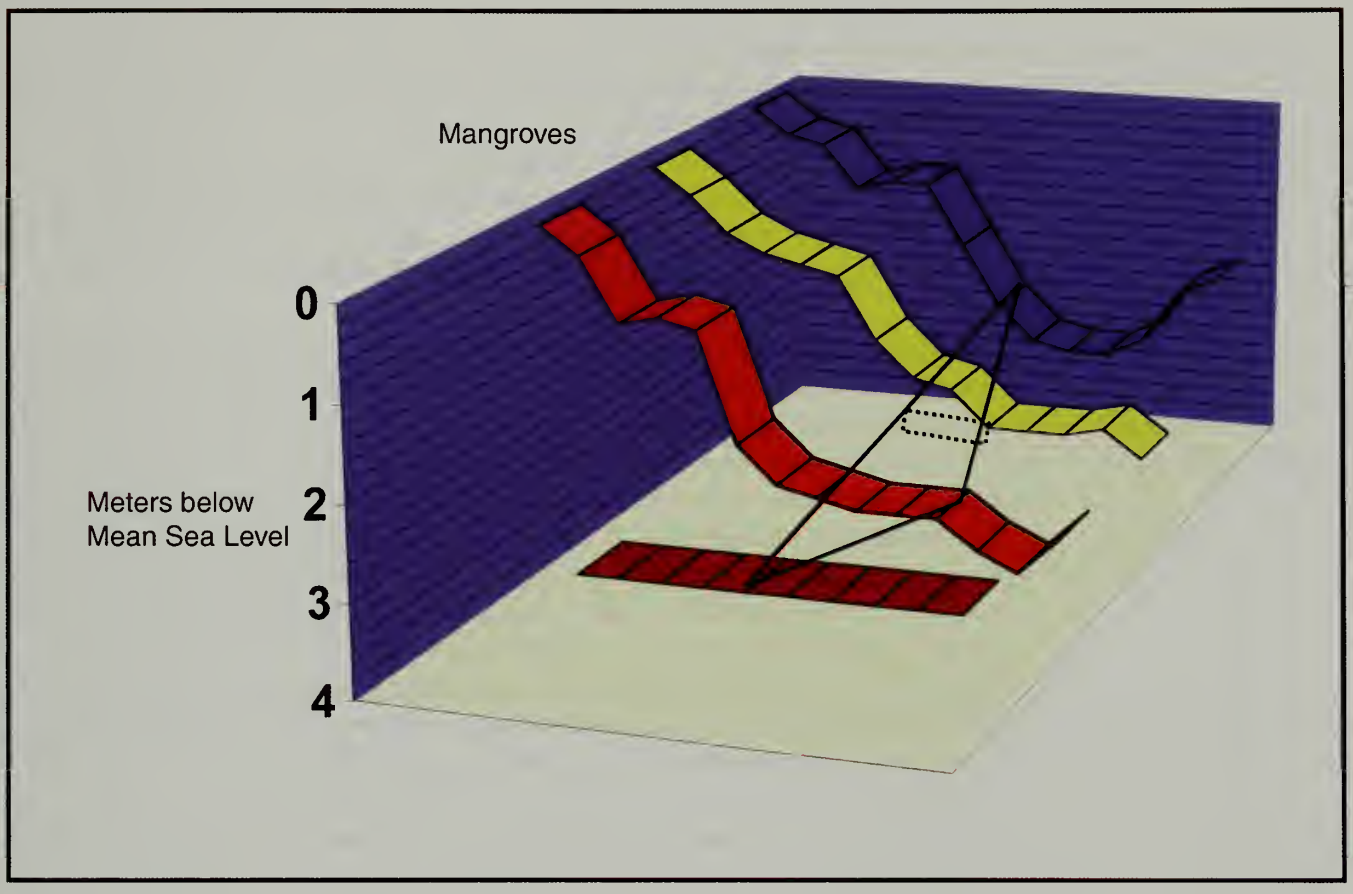
Datum stakes were brass rods with an end cap. Datum markers were set at the north and south ends of the site. A third datum was set in the middle of the site, along the western site limits. A triangular baseline was established by running a line from datum to datum, encompassing all of the exposed site area. This provided three segments (A-C) to use for mapping artifacts and features. The baseline was measured out and marked in feet. Exposed artifacts and vessel features were then mapped by trilateration. Exposed and diagnostic artifacts were recovered to prevent later erosion or looting activities, and to aid in vessel identification. These were labeled with provenience number and placed in plastic bags. Recovered materials were entered on a master artifact log.

The location and size of the test excavation was determined by Phase I remote sensing, site mapping, and site conditions. Excavation was conducted by fanning the loose sediments by hand and carrying them off-site with a three-inch induction dredge. Ballast stones were picked up and piled a short distance from the excavation area where they could later be replaced with ease. An induction dredge was used to remove material suspended by hand fanning to a temporary dump off the excavation site. The excavation areas were later backfilled with this sediment and with sand from the shore and from sandbags.

Dr. James K. Orzech created a depth contour of the site (Figure 14). This consists of four profiles taken from the channel to the shoreline across the wreck site. Depth data (in meters) was collected at every meter along each of the four profiles. These depths were taken at slack water during a period of low tide (mean low water). Although there is no great variation in depth across the site, the profiles clearly show how the channel itself flattens out toward the north end of the site boundaries.

Archaeological survey work on the site was usually limited to a window of a maximum of one- and one-half hours around slack tide due to strong tidal currents. Diving was conducted from a boat provided by NAS Key West, Oil Pollution Control Unit.

Bottom Profile for Boca Chica Channel Wreck 8MO1448



Solid line delineates survey area.
Dashed line delineates the main excavation trench.

Figure 14

Chapter Six Ship's Structure

Muir's 1991 site plan shows hull remains consisting of framing and outer hull planking protruding from the edges of the ballast pile. This plan indicated hull preservation underneath the ballast. However, after the Navy prohibited Muir from returning to the site, he was unable to verify the continued preservation of the hull remains. The reconnaissance dive carried out by Whall and Silvia confirmed by hand fanning that hull remains still survived even though barely covered by sediment and ballast stone. The 1997 reconnaissance and archaeological survey found the wreck to have only a shallow covering of ballast stone and sediment.

Three areas were excavated during the survey: one forward of midships; one directly over the mast step; and one aft of the mast step (see pocket site map). The forward area was the first area excavated and, as it would turn out, exposed an area of the hull's starboard side. This area contained a number of disarticulated and fragmentary hull remains including floor timbers, a single curved futtock, outer hull planking, loose planks that possibly were ceiling planking, and one small plank that could have been a limber board. The only articulated portion of the hull was found more deeply buried under the ballast pile. This section consisted of a relatively well-preserved segment of keelson nailed to the upper face of which was a mortised step. Below the keelson were floor timbers and the outer hull planking. These were preserved only for 21.7 to 23.6 inches (55 to 60 cm) on the port side. Two limber boards were present on the starboard side. A small excavation area aft of the first trench revealed the mast step, buttress, keelson, floor timbers, and some fragmentary outer hull planking. Further aft, the third excavation area revealed a scatter of artifacts, including some lead shot, a sandglass, and the sternpost's gudgeon, but no hull remains. In this area there was only a light scatter of ballast and a shallow layer of sand above the hard bottom. The keel did not survive in any of the areas excavated. The floor timbers and some fragmentary outer hull planking lay directly on the hard coral bottom. It seems likely that the keel was worn away by grinding against the oolite substrate.

From the wreckage surveyed it appeared that the hull came to rest on its starboard side. Fragments of lead caulking and the remains of chain plate with deadeyes, presumably from the upper strakes, indicate the position where the starboard hull remains came to rest. It is also apparent from the differing orientations of the keelson and some of the starboard strakes, that the starboard side became disarticulated from the centerline of the hull. The absence of the keel and severe damage to the garboard and bottom strakes on the starboard side indicate that the wreck continued to be ground against the hard oolite substrate. It is possible that the keel was completely ground away. The port side of the hull

apparently was not protected by ballast or sedimentation, and therefore deteriorated and was lost over time. It is possible that those hull sections could lie under the bank adjacent to the site. If so, then portions of the keel and port side could be preserved under the inshore sediment.

Eleven wood samples from the hull planking, ceiling, keelson, frames, mast step timbers, treenails, and shims were taken. The genus of each wood sample was identified by Regis B. Miller of the Center for Wood Anatomy Research, U.S. Forest Products Laboratory located in Madison, Wisconsin (Appendix III).

Keelson and Keel

Although the keelson, floor timbers, and mast step were found, no evidence of the keel was found below these timbers. It is possible that the keel was lost as the bottom of the wreck ground against the hard coral bottom. It is also possible that the keel and port side remains might have become disassociated from the rest of the shipwreck. The area underneath the mast step was probed, but no keel timber was located. However, a small piece of lead strip was present, possibly indicating a repair to the outer hull or keel.

The keelson was relatively well preserved and measured a maximum 7.5 inches (19 cm) sided at the mainmast step mortise; elsewhere it measured 5.5 to 6.3 inches sided (14 to 16 cm) and 4.7 to 5.1 inches (12 to 13 cm) molded. At the forward extent of its preservation, a step containing a mortise was nailed to the keelson's upper face. The mainmast step was a short distance aft of this step. The keelson was identified as in the white oak group, *Quercus* sp. Both iron bolts and treenails were present in the keelson, most in the vicinity of the mast step. Two treenails 1.4 inches (3.5 cm) in diameter were located in the keelson within the area of the mainmast step mortise. One treenail was centered directly in the center of the mortise. Forward of this treenail was a 1.2 inch (3 cm) diameter iron bolt, and 8.9 inches (22.5 cm) aft of it was an iron spike 0.8 inches (2 cm square). Another 3.5 inches (9 cm) aft of the spike was an iron bolt with a 1.6 inches (4 cm) diameter, and a hole from a missing bolt was located 8.9 inches (22.5 cm) farther aft. All of these fasteners were directly in the center of the keelson.

Mainmast Step and Forward Step

The mainmast step was found underneath the deepest portion of the ballast pile (Figure 15). It consisted of two timbers that formed a transverse mast step. These timbers fit laterally over the keelson and floor timbers as transverse riders or buttresses. These appear to have been constructed in this fashion to provide lateral support to the mast's heel. The forwardmost timber contained the mortise, while the after timber appeared to

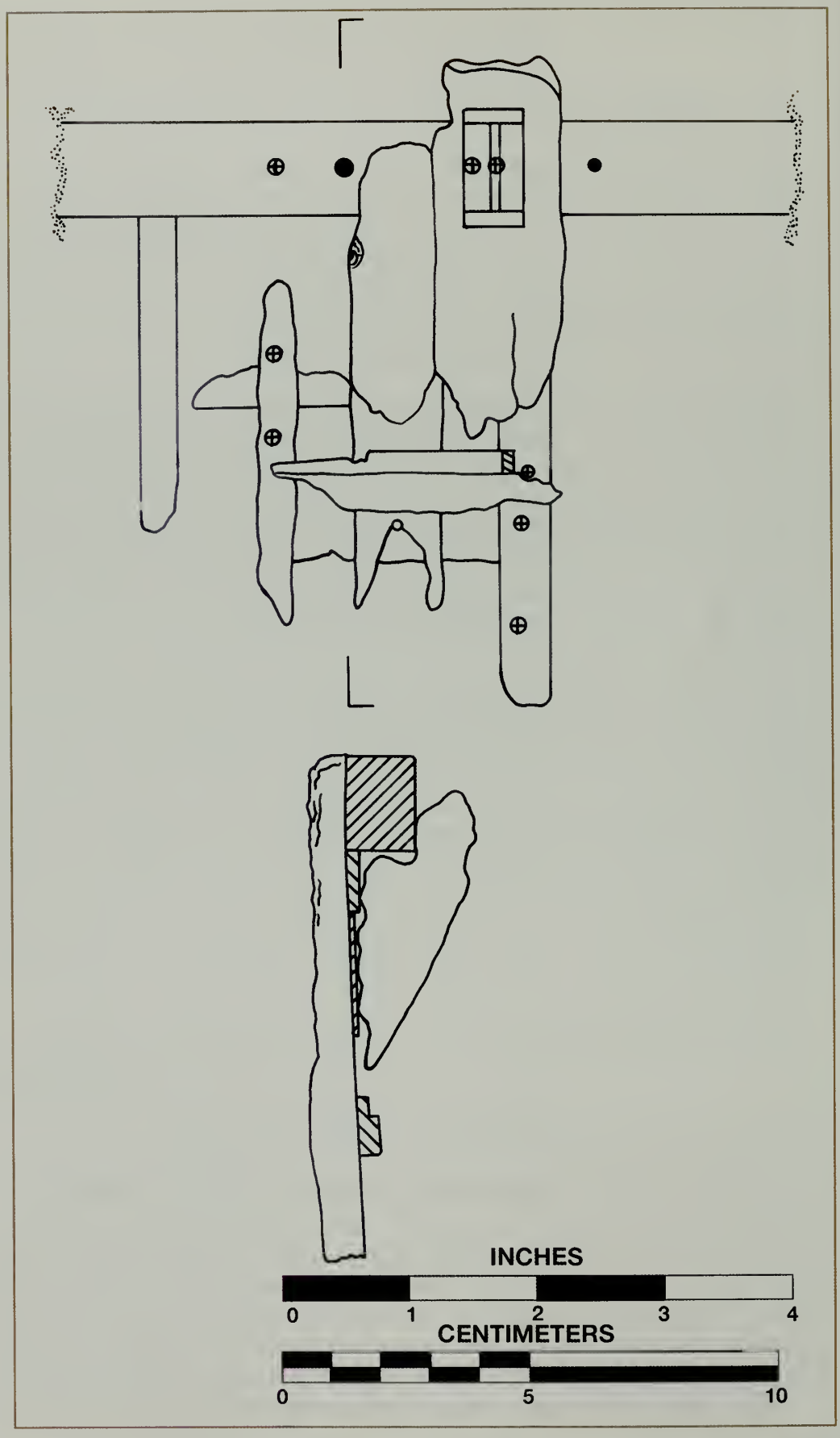


Figure 15 • Mainmast step.

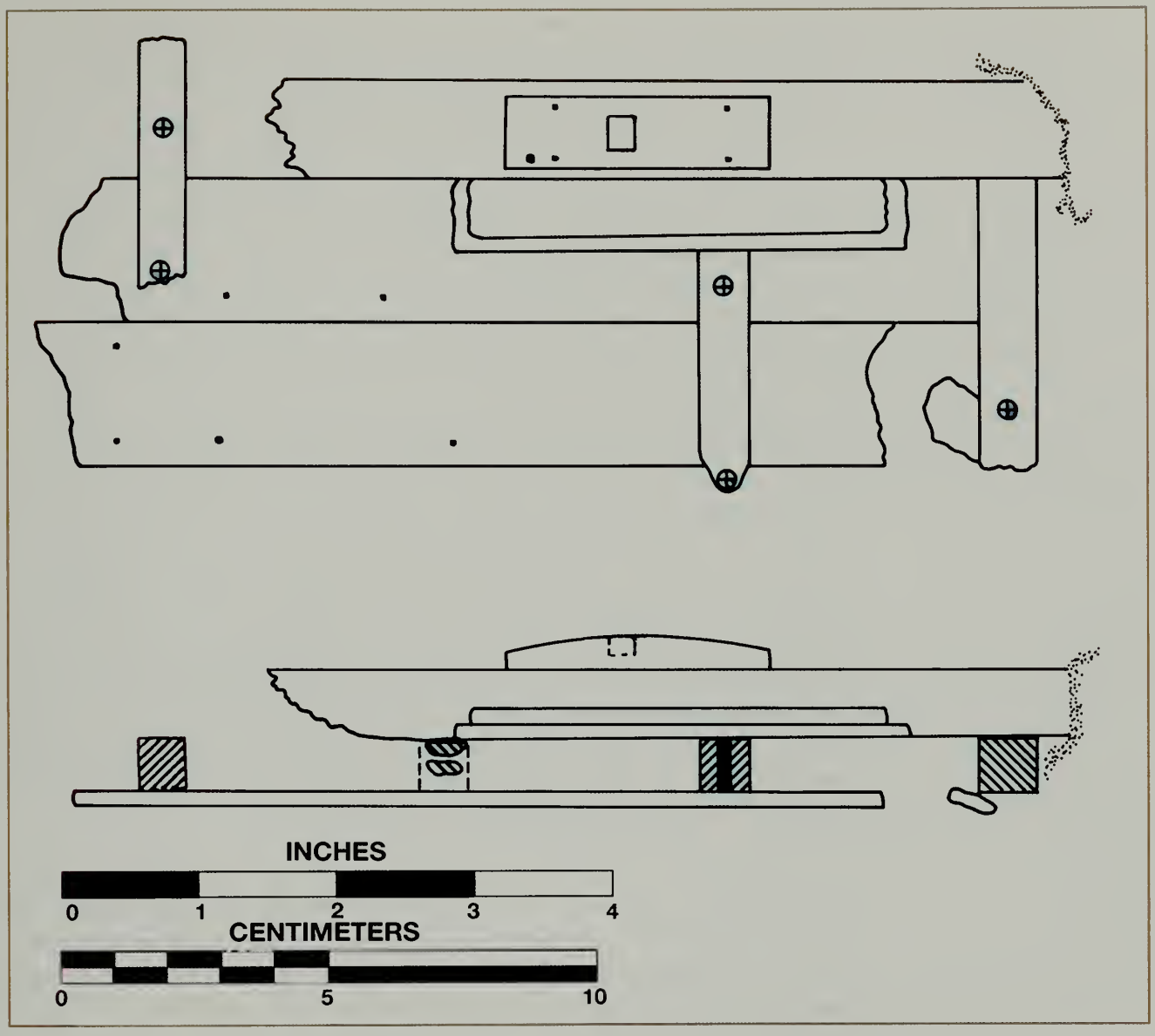


Figure 16 (above) • Forward step and starboard hull planks and frames shown in plan (top) and profile view (bottom).

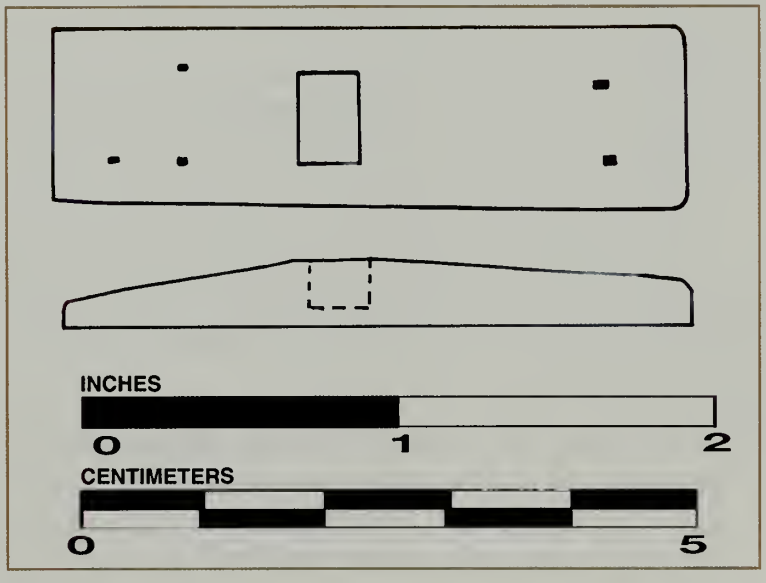


Figure 17 (right) • Detail of forward step shown in plan (top) and profile view (bottom).

function primarily to brace the mainmast step aft and laterally. The mainmast step, with a sided dimension of 10.2 inches (25.8 cm), was slightly heavier than the after timber, which had a width of only 5.5 inches (17 cm). Neither of these timbers was completely preserved. The port side halves were missing entirely and the starboard heels were not preserved at their extremities. The mainmast step proper was not fastened directly to the keelson, but was notched to saddle it. Two iron nails securing the heels to the floor timbers were the only evidence of fasteners. It is unknown how the after timber was fastened. A 0.8 inch (2 cm) square spike in the center of the keelson was directly underneath this timber, but it was not clear if it fastened the timber to the keelson. Presumably this timber would have had iron nails fastening its heels to the floor timber. By not fastening directly to the keelson, the ship's builder may have attempted to prevent damage to those timbers. This would also make it easier to replace the mast step. Both of the timbers rested on top of two floor timbers. Two shims or fillet pieces were placed between the frames and mast step timbers. The shims were used to adjust the fit of the mast step timbers on the floor timbers. The shim closest to the keelson was the thickest at 1.2 inches (3 cm), while the other was only 0.2 inches (0.5 cm) thick. The former was 4.7 inches (12 cm) wide and the latter 10.2 inches (26 cm). The bottom faces of both mast step timbers were notched to fit over the thicker shim. The mainmast step was of the white oak group, *Quercus* sp, and the after buttressing timber was of the yellow pine group, *Pinus* sp. The shim from underneath the mast step was also of yellow pine.

The mainmast step mortise was 9.8 inches (25 cm) by 4.7 inches (12 cm) and varied due to wear from 3.7 to 4.5 inches deep (9.5 to 11.5 cm). The mortise extended 1.2 inches (3 cm) over each side of the keelson. This space functioned to allow water to drain from the mortise. The keelson was stepped slightly within the mortise, and this notch may have aided in draining the mortise.

The heels of the mainmast step timbers were fragmented but appeared to have fit against a small footwale. On the starboard side, a 23.6 inch (60 cm) fragment of this footwale survived. Its maximum surviving width was 4.7 inches (12 cm) with a maximum thickness of 1.6 inches (4.1 cm). It had a 1.7 inch (4.2 cm) wide groove set 0.8 inches (2 cm) deep for the heels of the two mast step timbers. It was fastened to the floor timbers with iron nails. The footwale, like the after-most mast timber and shim, was of yellow pine, *Pinus* sp.

Transverse mast steps are known from other eighteenth-century shipwrecks from the Americas including the French and Indian War vessel *Boscawen* (Crisman 1988:142-143) and the Jamaica shipwreck designated "Readers Point Wreck" (Cook and Rubinstein 1995:104-105). The foremast on the model of a British bomb vessel from 1745 also is a transverse

mast step (Goodwin 1989:59-61). Moreover, a ship included in South Carolina's Underwater Heritage Trail, known as the Mepkin Abbey Shipwreck (38BK48), exhibits a transverse mast step. This wreck probably dates to the late eighteenth or early nineteenth century (Wilbanks 1981:55).

As noted previously, a smaller step was located at the forward extent of the preserved hull remains (Figure 16). The mortises of the two steps were 7 feet (215 cm) apart, measured from center. The forward step consisted of a small rectangular mortise, 2.8 by 2.0 by 1.6 inches deep (7.2 cm by 5 cm and 4 cm), cut into a chock 20.1 inches (51 cm) long, 5.7 inches (14.5 cm) wide, and with a maximum thickness of 2.2 inches (5.6 cm). The step was fastened onto the upper face of the keelson with three iron nails at its forward end and two iron nails at its after end (Figure 17). Both ends of the step were beveled, but the forward bevel had only a 0.9 inch (2.2 cm) thickness and was reduced more than the after end, which had a thickness of 1.4 inches (3.5 cm).

There are two possible functions for the smaller step. Because its position is only 7 feet (215 cm) from the mainmast step, and it is not strongly attached to the hull, it may be a step for a small foremast, the function of which might have been related to fishing. Small coastal fishing vessels frequently carry a foremast far forward. The second possible function is as a step for a stanchion, possibly one supporting the bowsprit. Its position, just a short distance forward of the mainmast step, would be in the right location for the after end of the bowsprit of a sloop.

Frames

Floor timbers were found still attached to the keelson. These were not preserved in their entire length. The floor timbers located on the keelson's port side at the small step were 3.5 inches (9 cm) sided and 3.9 inches (10 cm) molded, spaced 19.7 to 21.7 inches (50 to 55 cm) center to center with a 15.7 to 17.3 (40 to 44 cm) space between them. The floor timbers located at the main maststep ranged from 2.8 to 3.9 inches (7 to 10 cm) sided and 3.2 to 3.7 inches (8 to 9.5 cm) molded. An exception was the large floor timber upon which the mast step was placed, which was 6.9 inches (17.5 cm) sided and 3.2 inches (8 cm) molded. At the mast step, spacing was 9.5 to 10.2 inches (24 to 26 cm) center to center and the space between frames was 4.1 to 4.7 inches (10.5 to 11.8 cm). A sample from one of the floor timbers was identified as from the white oak group, *Quercus* sp.

Portions of other disarticulated frames were uncovered in the excavation areas. Of these, only a futtock from the turn of the bilge could be oriented to the hull's centerline. This one disarticulated futtock, found loose, revealed the shape of the turn of the bilge. Its lower leg was 25.6 inches

(65 cm) long, while its upper arm was only 13.8 inches (35 cm) long. It was a maximum of 4.3 inches (11 cm) sided and 4.3 inches (11 cm) molded. It appeared to have been lightly fastened to the hull, for only one half of a treenail hole and a single nail hole were located above the turn of the bilge where the first side strake would have been. There were no metal fasteners observed where the leg of the futtock would have fit against the bottom of the hull. The only other metal fasteners were two small nails on the upper-sided face, which would have held a ceiling strake. The lower leg contained a limber hole 1.4 to 1.6 inches (3.5 to 4 cm) wide and 0.8 inch (2 cm) deep. There was also a notch on the bottom of the futtock located at the juncture of the bottom and side of the hull. Like the limber hole, it was cut 1.4 to 1.6 inches (3.5 to 4 cm) wide and 0.8 inches (2 cm) deep. It might have functioned as a limber hole, or have been notched to fit over a repair. Treenails originally used to fasten hull planking were 1.1 to 1.2 inches (2.8 to 3 cm) in diameter. No wedges were observed in the treenails. In most cases, treenails were placed approximately in the center of the frames. Two treenails were identified as in the white oak group, *Quercus* sp.

No frames were found that might represent the upper-most futtocks or top timbers.

Outer Hull Planking

The hull planking was not well preserved. Hull planking fragments existed in the area of the mast step but were badly eroded. Other disarticulated hull planking was found in the area forward. The best preserved section of hull planking was the garboard and second strake on the port side, located near the small step. Two iron nails securing the garboard and second strake were well preserved and still fastened to the floor timbers. A wood sample taken from the hull planking was identified as Spanish cedar, *Cedrela* sp. The hull planking was 1.2 to 1.6 inches (3 to 4 cm) thick, the garboard 10.6 inches (26.8 cm) wide, and the second strake 11.8 inches (30 cm) wide. Although elsewhere the hull planking was completely missing, several strips of lead caulking were found *in situ*. The provenance of these approximates the position of the joins of now missing hull strakes. At the northern extremity of the forward excavation area, two deadeyes with chain plates were recorded. The provenance of these indicates the location of the deteriorated hull's upperworks.

Ceiling Planking and Limber Boards

Ceiling planking was preserved on both the port and starboard sides of the forward step. Two pieces were found on the port side of this step. One of these was loose, possibly a limber board, and rested above another piece, which was fastened to the frames with iron nails. The planks were

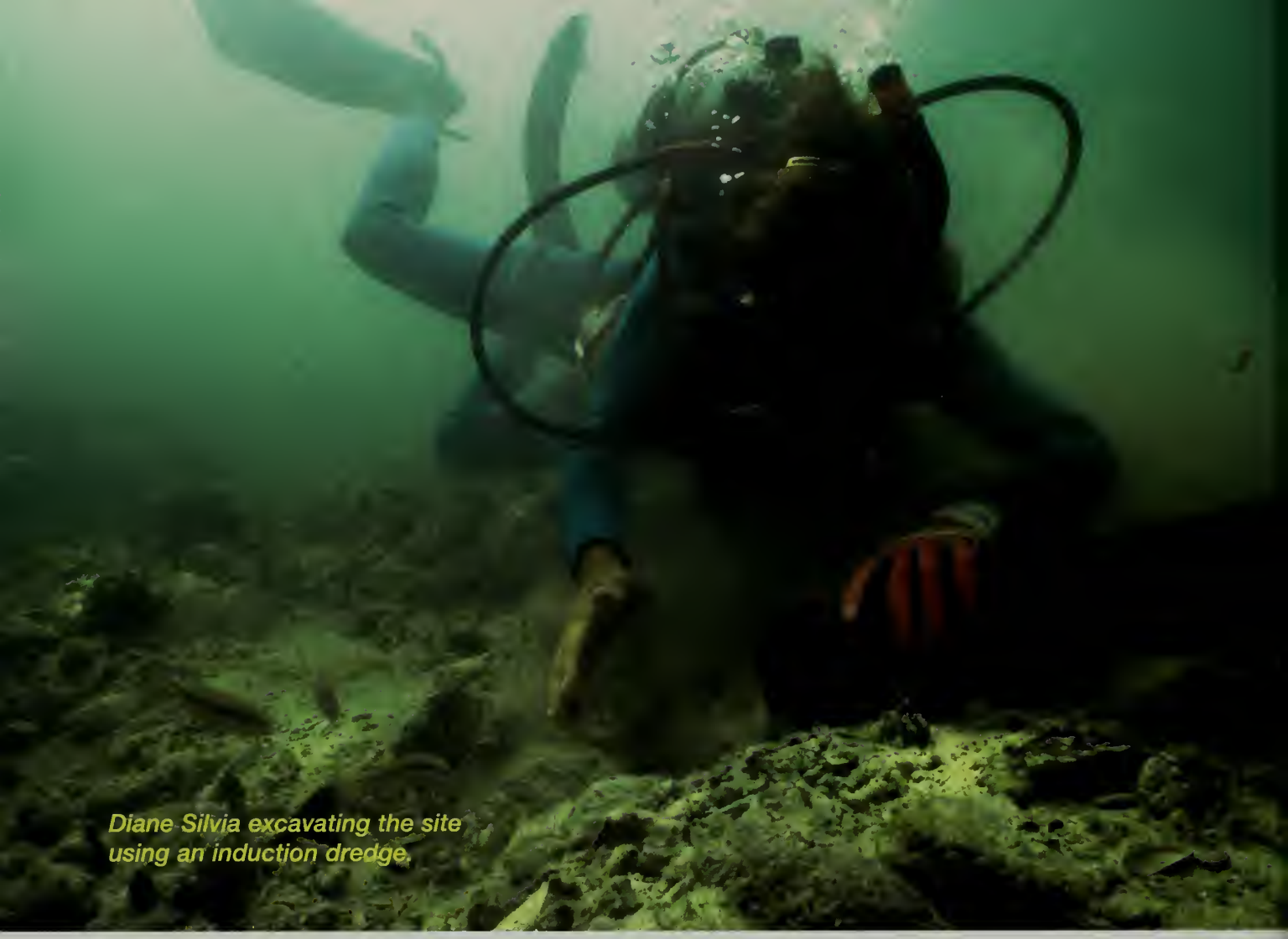
1.2 inches (3 cm) molded and 4.3 to 5.5 inches (11 to 14 cm) sided. The smaller plank was 31.5 inches (80 cm) long and the larger was 34.3 inches (87 cm long). The ends of three ceiling planks were exposed on the starboard side. They were 0.4 to 1.2 inches (1 to 3 cm) molded and 2.4 to 5.5 inches (6 to 14 cm) sided. The ceiling plank closest to the keelson had a 6.3 inch (16 cm) long notch cut 0.4 inches (1 cm) deep along its edge.

Another loose plank not associated with any hull timbers was found in the forward excavation area. This may have been a limber board because its small size and the lack of any fasteners would be consistent with a removable ceiling plank. It was somewhat trapezoidal in aspect with a maximum length of 14.1 inches (35.8 cm) and minimum of 12.2 inches (31 cm), width of 9.8 inches (25 cm), and thickness of 1.2 to 1.6 inches (3 to 4 cm). On one corner this plank had a 0.4 inch (1 cm) wide bevel, perhaps evidence of being trimmed to fit.

Several other disarticulated timbers were observed in the forward excavation area. Some of these appeared to be ceiling planks because they lacked treenails that would have been present in the hull strakes. One of these planks was charred.

Repairs

All of the lead strips recovered both by Muir and the excavation team had been used to repair the outer hull planking seams. Use of lead for repairs has been observed on both medieval and post-medieval wreck sites from the Mediterranean and the Spanish New World (Reith to Neyland 1997), and a number of examples of similar lead strips were found on the Spanish wreck of *El Nuevo Constante* lost off the Louisiana coast in 1766 (Pearson and Hoffman 1995:146-47). Lead strips found on the Boca Chica Channel Wreck indicate a number of repairs to the outer hull. It is likely that the ship had been in use for several years, thus requiring repairs to the hull. According to Clayton (1980:72), vessels built in Havana reportedly had twice the life of those built in Spain. If this statement is correct, and the vessel was built in Havana, it could have seen many years of use prior to its loss.



Diane Silvia excavating the site using an induction dredge.

Chapter Seven

Artifact Assemblage

Artifacts recovered from the Boca Chica Channel Wreck range in date from the middle of the eighteenth century to the first half of the twentieth century. The only artifact dating to a period earlier than the eighteenth century is a small, aboriginal, shell-tempered, ceramic sherd. This artifact may have drifted onto the site from known prehistoric sites on the nearby shore. Most of the artifacts were in moderately good but fragmented condition. Long-dead remnants of coralline algae were present on outer surfaces of some of the artifacts, revealing that they had been subject to a period or periods of exposure since the wrecking event.

The following descriptions of artifacts recovered during the 1997 fieldwork, and by Muir over the years beginning in 1974, are based on a preliminary assessment of the objects in varying states of conservation. Each item recovered in 1997 was given a consecutive number preceded by the field season (e.g., 97-04). Artifacts received from Muir were given consecutive numbers preceded by "Muir" (e.g., Muir 66). These numbering systems represent original field numbers or temporary acquisition numbers that will be replaced by a permanent catalog numbering system at

the conclusion of conservation. The artifacts discussed are categorized according to their function as, for example, ship's hardware, weapons, or cookware and utensils. Items of indeterminate age and those that are clearly intrusive to the wreck site are grouped separately.

Ship's Hardware

Lead Sheathing Strips

Muir recovered several lead sheathing strips used for the hull planking seams (Muir 71). Archaeologists recovered several more in 1997 (97-49, Figure 18). The strips vary in length and width; the longest is 42.0 inches (106.7 cm) long, 2.75 inches (7.0 cm) wide, and 0.2 inches (0.4 cm) thick. Nearly all of the lead strips exhibit a longitudinal groove along the center, probably the result of having been pressed into the space between planks. Tack holes pierce the edges of each strip, and on some examples, the roughly circular impression of tack heads are preserved. Tack holes are approximately 0.125 to 0.3 inches (0.3-0.8 cm) in diameter, placed 0.06 to 0.5 inches (0.1-1.3 cm) from the strip edge, and spaced approximately 0.625 to 1.125 inches (1.59-2.86 cm) center to center. Tack head impressions are 0.375 to 0.5 inches (0.9-1.2 cm) in diameter. These strips were used for repairs as discussed in Chapter VI.

Iron Hardware and Fasteners

Several wrought iron artifacts were recovered in 1997. These items were heavily concreted and some had corroded away completely, leaving only an empty mold inside their marine concretion shells. After the concretions were x-radiographed to reveal their contents, replicas of the objects were created by making epoxy resin castings inside the concretion molds.

One of the items was a large, U-shaped, strap-like object (97-07, Figure 19), originally composed of a wrought iron band pierced with eight holes, six of which had fasteners through them. This concretion was originally believed to be one of the ship's pintles because of its shape, and would have been appropriately sized in relation to the gudgeon concretion that was identified (but not collected) at the stern end of the site. However, after casting the 97-07 concretion, it became clear that it was not a pintle. From the epoxy cast, it appears that the object was hand-formed from 2.0 inch (5.2 cm) wide by 0.3-0.4 inch (0.8-1.0 cm) thick wrought-iron bar stock. Each fastener was a bolt with a domed head approximately 1 inch (2.5 cm) in diameter, and a shaft 3.25-3.4 inches (7.2-7.6 cm) long, squared near the head, changing to round and threaded. Attached to the threaded end of each bolt was a square nut 0.625 to 0.75 inches (1.5-1.9 cm) on a side. During casting, a 1.2 inch (3 cm) diameter washer was found accreted to the surface of the object. This was originally associated with the fastener that passed through one of the two "feet" of the object.

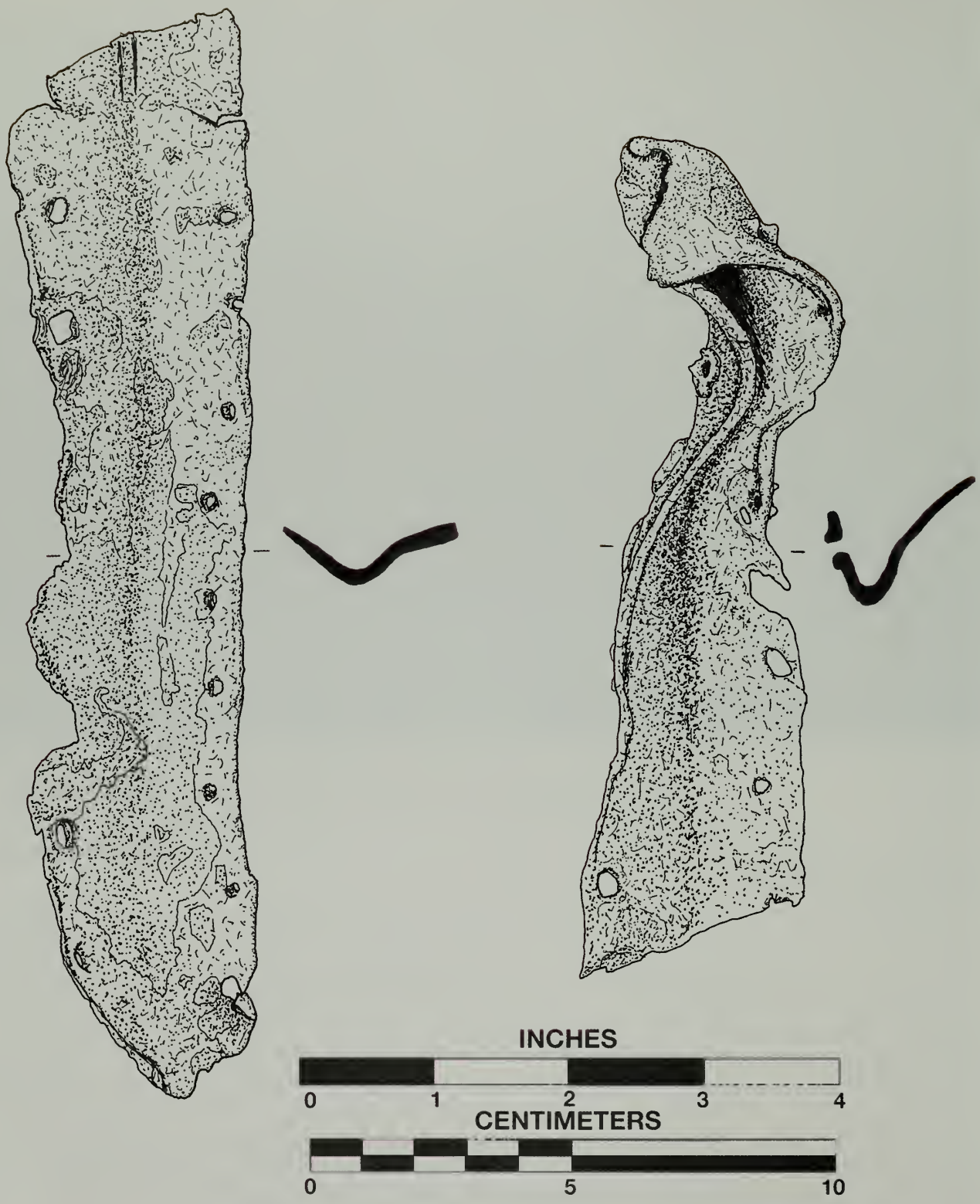


Figure 18 • Lead sheathing strips (97-49).

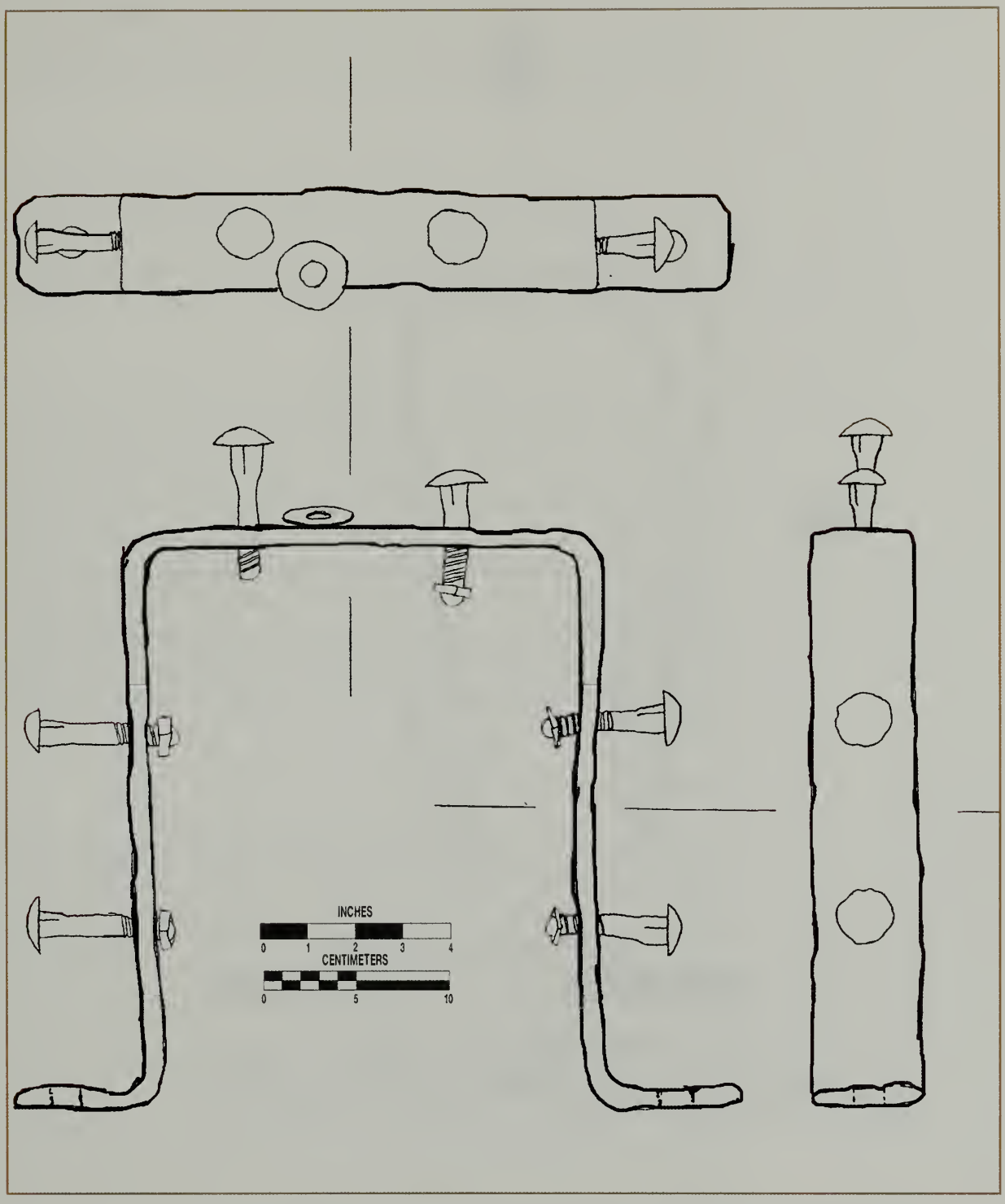


Figure 19 • Epoxy cast of the 'U'-shaped strap-like object originally composed of a wrought iron band with hand-made fasteners (97-07).

A slightly raised area around one of the holes is probably an area of differential corrosion that was once under this or another washer. The maximum overall dimensions of the "strap" are 14.25 inches (36.3 cm) by 12.0 inches (30.5 cm).

No positive identification of this U-shaped iron object has been made. Various suggestions include: a repair strap; a gammon iron for the bowsprit; a bracket for the base of a hollow figurehead; and a bracket/support for the base of a pump well. It is also possible that the item was part of a non-ship-related object on board, was carried as scrap iron, or is intrusive to the site.

A concretion containing the mold of an iron "staple" (97-10, Figure 20) was found in the vicinity of the mainmast step. Upon excavation, this concretion closely resembled a hook so it was originally believed to be part of the rigging. However, after x-raying and resin casting it became apparent that this object was a staple-like fastener 3.75 inches (9.3 cm) long. Similar specimens have been recovered from other colonial-era shipwrecks, including an eighteenth-century sloop wrecked off of Reader's Point, Jamaica (Cook and Rubenstein 1995); the *Betsey*, a British collier abandoned at Yorktown during the American Revolution (Broadwater 1996:62-64); and a late seventeenth-century Dutch freighter wrecked on the Zuiderzee in the Netherlands (Neyland and Schröder 1996:55-56).

Anchor

Muir collected pieces of a small, heavily concreted iron boat anchor (Muir 70, Figure 21) in the late 1980s. Only one arm survives, but reconstruction shows it originally had two arms. Its shank length is only 25.2 inches (64 cm), and the remaining arm and fluke are only 9.1 inches (23 cm) long. An anchor of such slight proportions may have been deformed during use, perhaps losing an arm. The throat, or angle formed between the arm/fluke and shank, is relatively acute. According to Cotsell (1856:2), French anchors from the late eighteenth and early nineteenth centuries often exhibited a more sharply angled throat than did their British, Danish, Dutch, or Swedish contemporaries. Cotsell's observation however, pertained to large ship anchors and may not apply to small boat anchors such as the example recovered from the Boca Chica Channel Wreck.

Rigging

Three concretions containing deadeyes and chainplates were observed on the wreck's starboard side. Only part of one of these concretions, a possible iron chainplate (97-12), was recovered because of the expense and difficulty involved in conserving such objects. Two of these concretions

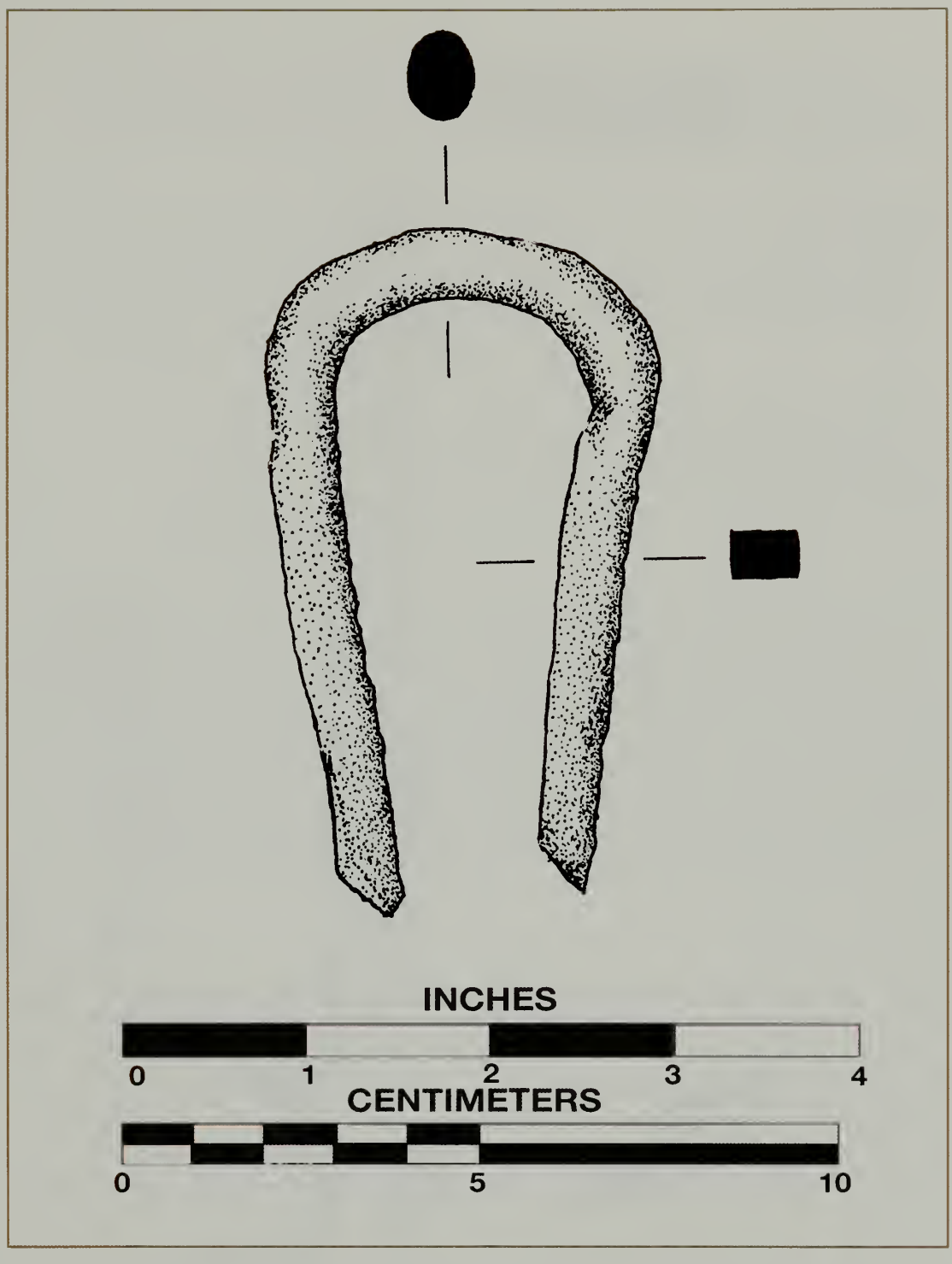
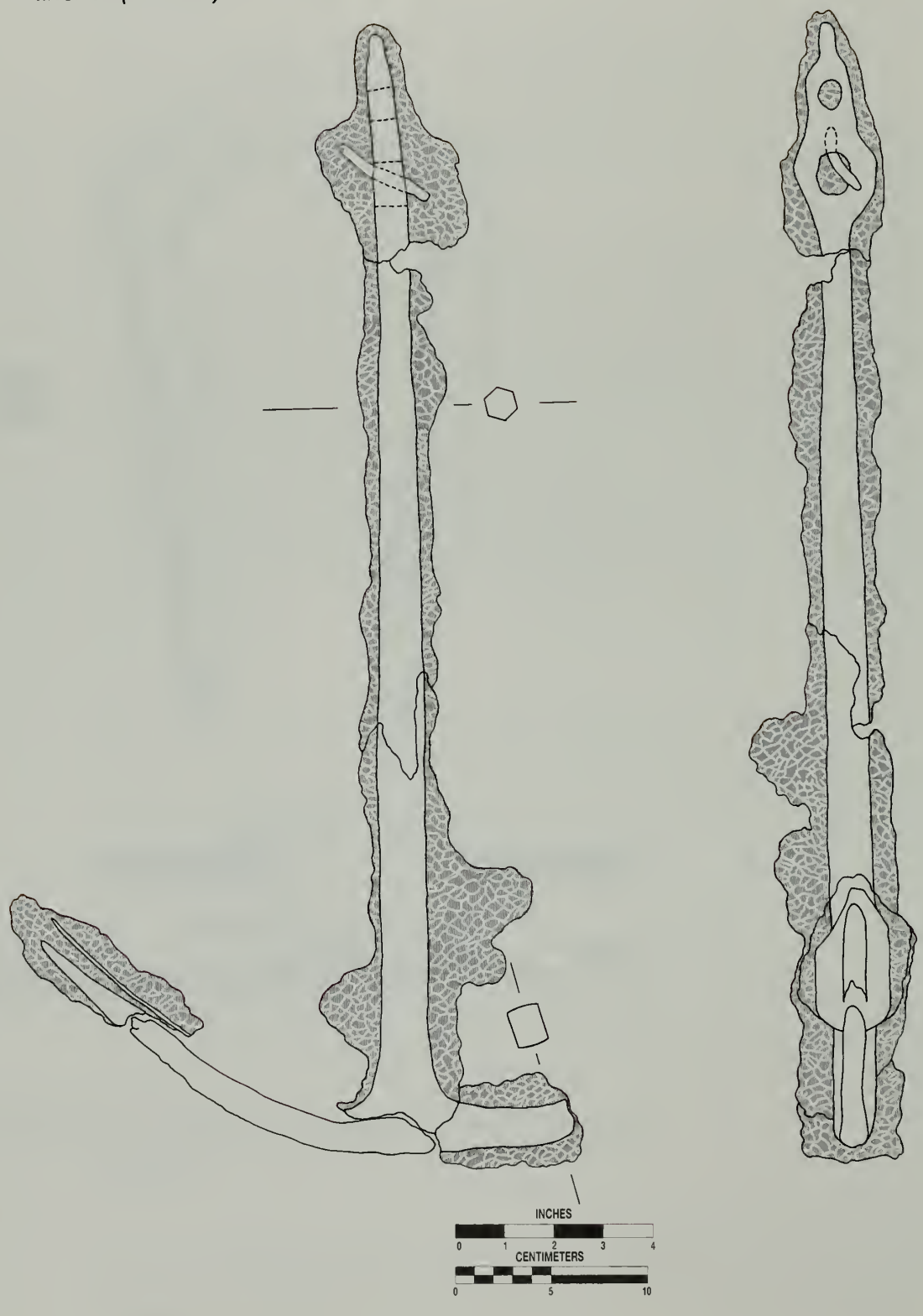


Figure 20 • Epoxy cast of an iron "staple" from a concretion mold found in the vicinity of the mainmast step (97-10).

Figure 21 • A heavily-concreted small boat anchor (Muir 70).



were found in a location that could approximate the position of the sheerstrake on the collapsed starboard side. The concreted strapping for the third deadeye was lying on top of the ballast on the southeast portion of the wreck site and may be from the collapsed port side of the hull.

The concretion of a boom iron (97-35B) was located near the centerline of the ship approximately 8.2 feet (2.5 m) aft of the mast step. Boom irons commonly consist of two iron strap loops joined with a central iron spacer to form a rough "figure 8." A description of their use is provided in *The Wreck of the Auguste* (Parks Canada 1992:59):

> In light winds, ships . . . added sails, called studding or stunsails, to the outer ends of the regular square sails. To do this, sailors slipped a boom iron over the yardarm and then inserted a smaller boom through the top hoop of the boom iron. The stunsails were flown from this smaller boom.

Except for a square remnant of iron metal between the two straps, most of the boom iron had completely corroded away, leaving a nearly hollow concretion mold. This was cast with epoxy resin to create a replica of the original artifact (Figures 22 and 23), measuring 10.5 inches (26.8 cm) long, with a metal thickness of approximately 0.25 inches (0.7 cm). This boom iron had one round loop strap (diameter 4.7 inches [11.9 cm]) and one rectangular strap that were designed to fit over the ends of the yard arm and boom (Lever 1843:32). This artifact exhibits torsional stress possibly caused by the studding sail having been wrenched away from the yard.

Tackle

The only wood artifacts apart from samples removed from the site in 1997 were a sheave (97-04, Figure 24) and what was believed to be a small block (97-53). Upon cleaning and close examination in the lab, it became apparent that 97-53 was not a block, but simply the remaining portion of a larger piece of wood that was destroyed through shipworm (*Teredinae* sp.) burrowing, and other site formation processes. Corrosion products from the two iron nails that once pierced it likely acted as a physical barrier against further deterioration. The *lignum vitae* sheave was found along the centerline of the ship approximately 8.2 ft (2.5 m) forward of the remaining intact timbers. Shipbuilders preferred *lignum vitae* for sheaves because of its hard, durable, and self-lubricating properties (Brown 1977:31). This 4 inch (10 cm) diameter, 1 inch (2.5 cm) thick sheave may have been part of a block used in the running rigging, or in tackle for handling cargo or ordnance, or may have been stored in the hold for later use. Several spare *lignum vitae* sheaves were found on *Boscawen*, a French and Indian War sloop dating to 1759 (Crisman 1988:145).

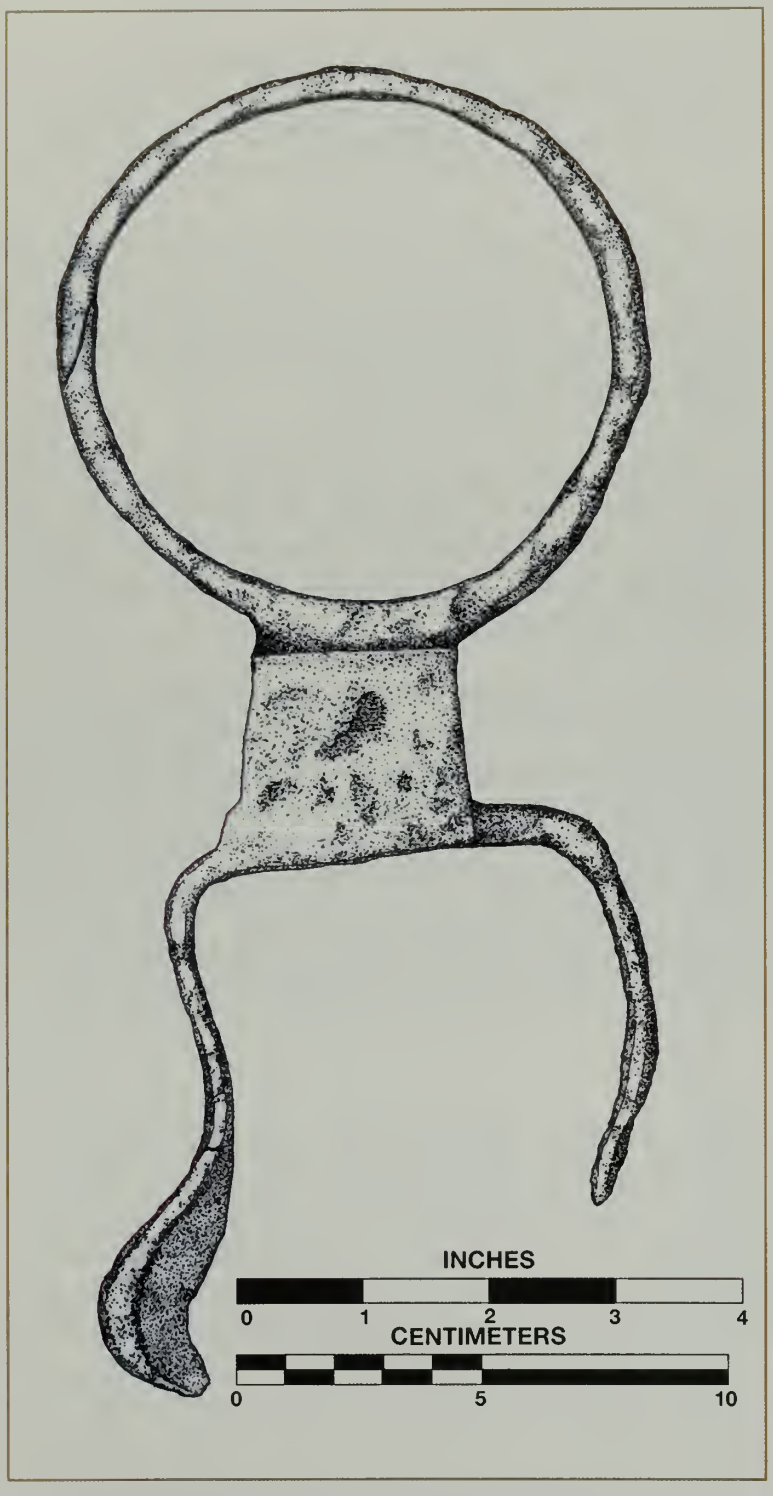


Figure 22 • (Left) Epoxy cast of a heavily concreted boom iron (97-35B).

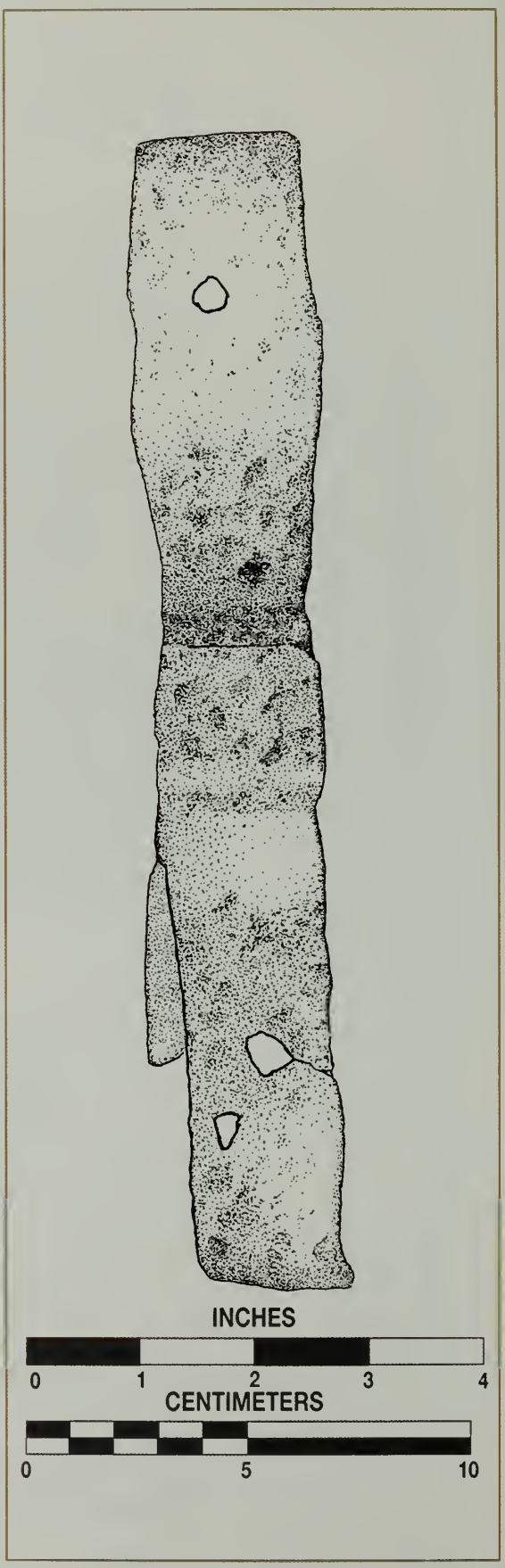


Figure 23 • Epoxy cast of the concretion mold of a boom iron, side view (97-35B).

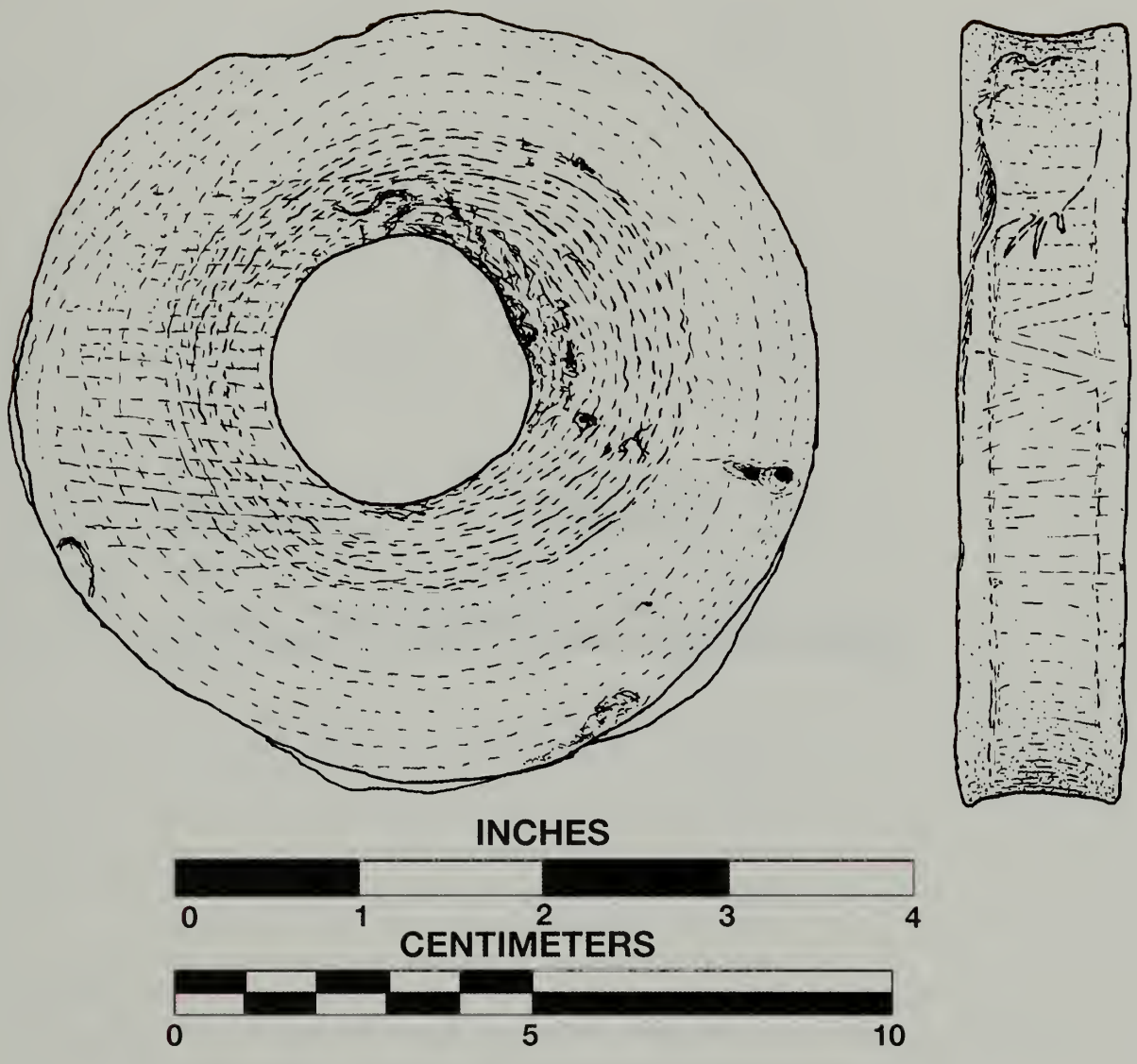


Figure 24 • Lignum vitae *block sheave (97-04).*

Weapons

Lead Shot

In 1997, excavators discovered clusters of lead balls (97-17, 97-26B, 97-27A, 97-40, and 97-41, Figure 25) that range from musket ball size to small shotgun type shot. Muir also raised one piece (Muir 64). The cast lead balls are not uniform in diameter. As explained by Peterson (1969:33), "few eighteenth century or earlier undeformed balls are actually round, for, due to the method used in routing out their molds, they are usually wider from side to side than from front to back."

Table 1 lists the dimensions of the lead shot raised from the site. Shot that are not perfectly round are assigned an approximate diameter calculated as the average of the smallest and largest dimensions. Shot that are significantly corroded are assigned a maximum preserved diameter. Given the wide variety of musket and pistol calibers in use during the eighteenth century, and their designated "windage," or the space between the inside of the bore and the ball, any attempt to assign these artifacts to a type of weapon would be complicated. Also, some or all of the shot found on the wreck site could be canister shot, in which case there would be no correlation between shot diameter and weapon type. Some of the shot (97-40) have the characteristic dimple of Rupert shot. Rupert shot, named for English Prince Rupert, was found on the Trudeau Site, a French site in Louisiana, and has been described by Brain (1979:208):

> [The shot] are in all sizes and range from .117–.184 inches in diameter (2.79–4.67 mm). Their appearance is very distinctive: a spheroid with one side more flattened than the other and a dimple in the flattened side. I believe these are examples of shot either invented or popularized by Prince Rupert of England about 1665, and used until about 1769, when drop shot was introduced. The earlier method employed a special brass plate with a 3- or 4-inch dish-shaped concavity in the center. The concavity was similar to a colander, with holes approximately the size of the shot to be made, and was much thinner than the surrounding rim of the plate, which was intended to hold the heat. The brass plate was suspended above a tub of water and was heated by placing burning charcoal in the concavity. When brought up to heat, melted lead, fluxed with arsenic, was poured through the coals and the sieve and fell into the water as more or less round pellets.

Brain further describes certain shot used for fowling. This shot was sold in decreasing order of size for "wild goose, ducks, doves, royal and half-royal" (Brain 1979:208). An inventory of supplies for the Louisiana

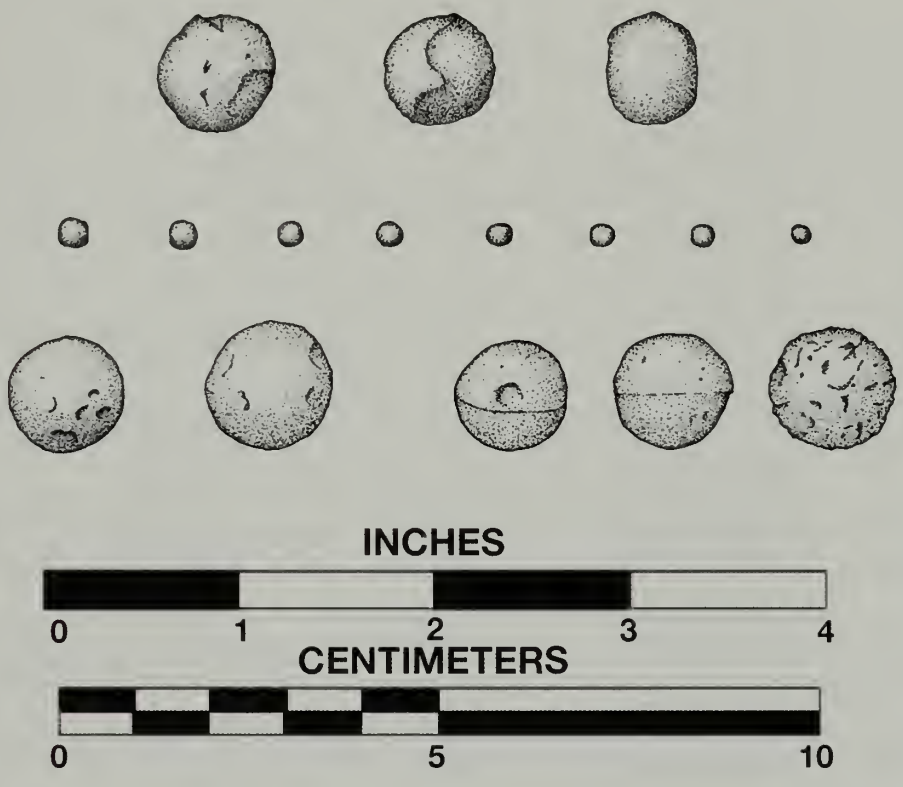


Figure 25 • Lead shot (97-17, 97-26B, 97-27A, 97-40, and 97-41).

TABLE 1 CAST LEAD SHOT DIMENSIONS

ARTIFACT NUMBER	DESCRIPTION	SMALL DIMENSION	LARGE DIMENSION	AVERAGE DIAMETER	WEIGHT
Muir 64	Round, smooth, some rounded pits.	0.61 in (1.55 cm)	0.61 in (1.55 cm)	0.61 in (1.55 cm)	0.785 oz (22.3 g)
BCC 97-17A	Round, some surface loss.	0.59 in (1.5 cm)	0.61 in (1.55 cm)	0.60 in (1.53 cm)	0.718 oz (20.4 g)
BCC 97-17B	Round, mold seam clearly visible, smooth surface.	0.59 in (1.5 cm)	0.55-0.59 in (1.4-1.5 cm) on mold line	0.59 in (1.5 cm)	0.641 oz (18.2 g)
BCC 97-17C	Round, mold seam visible, smooth surface with some deformation.	0.55 in (1.4 cm)	0.55-0.57 in (1.4-1.45 cm) on mold line	0.56 in (1.43 cm)	0.595 oz (16.9 g)
BCC 97-26	Round, smooth, several large dimples and slightly flattened areas.	0.67 in (1.7 cm)	0.67 in (1.7 cm)	0.67 in (1.7 cm)	1.067 oz (30.3 g)
BCC 97-27A	Round, relatively smooth surface.	0.55 in (1.4 cm)	0.55 in (1.4 cm)	0.55 in (1.4 cm)	0.605 oz (17.2 g)
BCC 97-40A	Round, possible mold seam, one flattened area, some surface loss.	0.55 in (1.4 cm)	0.59 in (1.5 cm)	0.57 in (1.45 cm)	0.588 oz (16.7 g)
BCC 97-40B	Cylindrical, one end rounded, other end slightly concave to flat, some surface deformation and flattening.	0.35-0.43 in (0.9-1.1 cm) diameter	0.47 in (1.2 cm)	n/a	0.327 oz (9.3 g)
BCC 97-40C	Round, heavy surface loss and deformation, some original surface, deep rounded pits.	0.57 in (1.45 cm), or 0.51 in (1.3 cm) with loss	0.59 in (1.5 cm)	0.58 in (1.48 cm)	0.605 oz (17.2 g)
BCC 97-40D-1	Roughly cylindrical, flattened ends.	0.14 in (0.35 cm)	0.16 in (0.4 cm) diameter	n/a	0.014 oz (0.4 g)
BCC 97-40D-2	Roughly cylindrical, ends flattened and dimpled.	0.12 in (0.3 cm)	0.14 in (0.35 cm)	n/a	0.011 oz (0.3 g)
BCC 97-40D-3	Tiny round pellet.	0.08 in (0.2 cm)	0.1 in (0.25 cm)	0.09 in (0.23 cm)	0.004 oz (0.1 g)
BCC 97-40D-4	Round with one flattened face.	0.1 in (0.25 cm)	0.12 in (0.3 cm)	0.11 in (0.23 cm)	0.007 oz (0.2 g)
BCC 97-40D-5	Cylindrical with flat ends.	0.1 in (0.25 cm)	0.14-0.16 in (0.35-0.4 cm)	n/a	0.011 oz (0.3 g)
BCC 97-40D-6	Round, flattened, one side dimpled.	0.08 in (0.2 cm)	0.14 in (0.35 cm)	0.11 in (0.28 cm)	0.007 oz (0.2 g)
BCC 97-40D-7	Tiny pellet, one side dimpled, one side rounded.	0.12 in (0.3 cm)	0.14 in (0.35 cm)	0.13 in (0.33 cm)	0.011 oz (0.3 g)
BCC 97-40D-8	One side rounded, one side flattened.	0.1 in (0.25 cm)	0.12 in (0.3 cm)	0.11 in (0.28 cm)	0.007 oz (0.2 g)
BCC 97-41A	Round, mold seam visible, surface dimples, pits and deformation.	0.55 in (1.4 cm)	0.57 in (1.45 cm) on mold line	0.56 in (1.43 cm)	0.570 oz (16.2 g)
BCC 97-41B	Round, heavy surface loss and deformation.	0.59 in (1.5 cm)	0.69 in (1.75 cm)	0.69 in (1.75 cm) est.	0.595 oz (16.9 g)
BCC 97-41C	Irregular shape, heavy surface loss and deformation.	0.43 in (1.1 cm) preserved	0.49 in (1.25 cm)	0.49 in (1.25 cm) est.	0.285 oz (8.1 g)
BCC 97-41D	Round, relatively smooth surface, mold line visible.	0.55 in (1.4 cm)	0.55 in (1.4 cm)	0.55 in (1.4 cm)	0.588 oz (16.7 g)
BCC 97-41E	Round, some surface deformation.	0.55 in (1.4 cm)	0.55 in (1.4 cm)	0.55 in (1.4 cm)	0.591 oz (16.8 g)
BCC 97-41F	Round, smooth, slight surface loss, tiny deep hole (0.1 cm).	0.67 in (1.7 cm)	0.69 in (1.75 cm)	0.68 in (1.73 cm)	1.045 oz (29.7 g)

Colony in 1733 contained a similar list of buzzard shot, duck shot, wild pigeon or royal, and half-royal shot (Brain 1979:296). The British system also correlated bird and shot size.

Iron Shot

Over the course of his many dives, Muir observed three iron round shot and four iron bar shot, most of them attached to ballast stones by concretion. He believed this shot was part of the ship's *materiel* and not scrap carried for ballast, in particular because he thought he observed gunpowder and wadding associated with the shot (Muir 1981). No iron shot were raised during the 1997 project.

By the end of the eighteenth century, ordnance sizes were largely standardized to a few common sizes. For example, the British Board of Ordnance recognized 11 different calibers in 1764 including: 1/2-; 1 1/2-; 3-; 4-; 6-; 9-; 12-; 18-; 24-; 32-; and 42-pounders (Peterson 1969:41). Manufacturing variations, differences in standardized sizes between countries with different weight systems (e.g., 1 French livre = 1.1 British pound), re-bored guns, and reuse of older ordnance of differing nationality (especially on non-navy ships), make it difficult to reconstruct a ship's ordnance based on the remaining shot. Based on their diameters, Muir believed the five pieces he raised were round shot for a 1-pounder, a 9-pounder, and a 20-pounder, and two ends from an 18-pound bar shot. However, corrosion may have changed the diameter of each shot so that its preserved dimensions are no longer the same as its original. It is difficult, therefore, to assign caliber to each shot with certainty. The preserved diameter of each shot and the closest correlating caliber are provided in Table 2.

Bar shot of the type archaeologists observed on the site in 1997, consisting of two halves of a spherical shot connected to each other with a bar, was commonly referred to as half-round bar shot, doublehead shot, or cross bar shot. The length of the connecting bar was commonly three times the diameter of the shot, but shorter and longer versions have been found in the historical record (Lavery 1987:137; Wilkinson-Latham 1973:27). Often ordnancemen filled the space around the bar with a flammable composition that would ignite when fired and could enflame enemy hulls and rigging.

Muir (1979) described the smallest iron shot he collected (Muir 59, Figure 26) as being in "poor shape." When first examined in the laboratory, it appeared to have a preserved diameter of approximately three inches (7.4 cm), with substantial areas spalled away. However, it had a thick layer of corrosion products enclosing a much smaller, complete shot 1.625 inches (4.1 cm) in diameter. At the time he found it, Muir hypothesized that the shot was a probable one-pound verso.

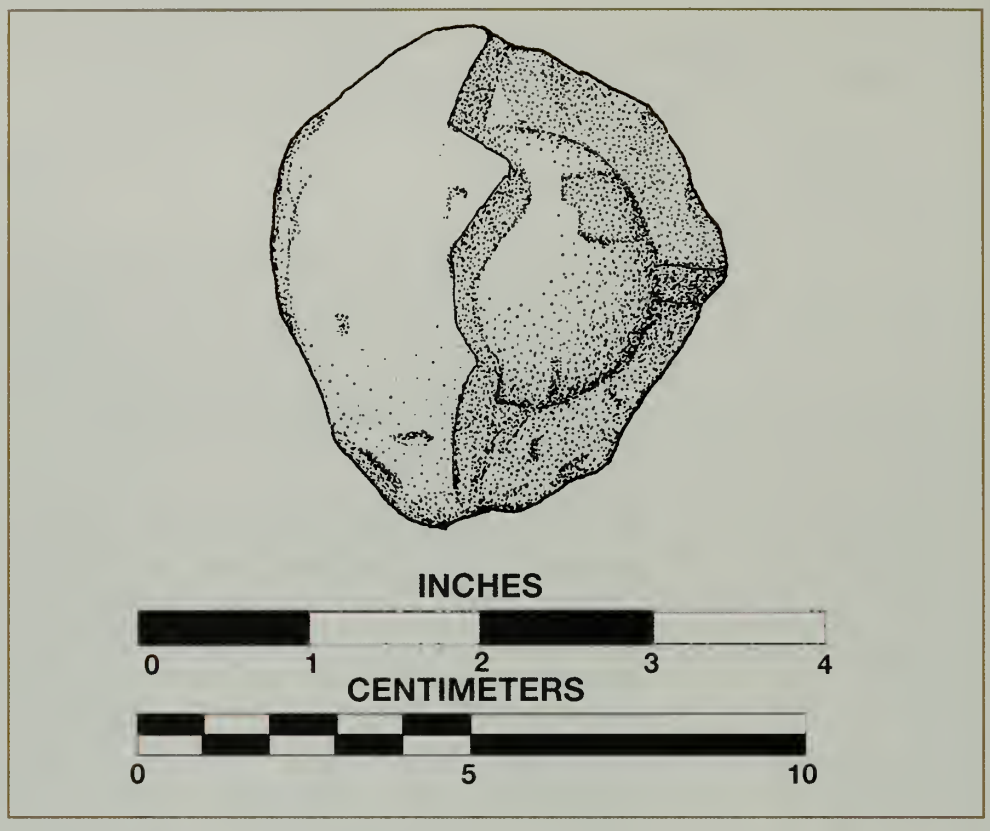
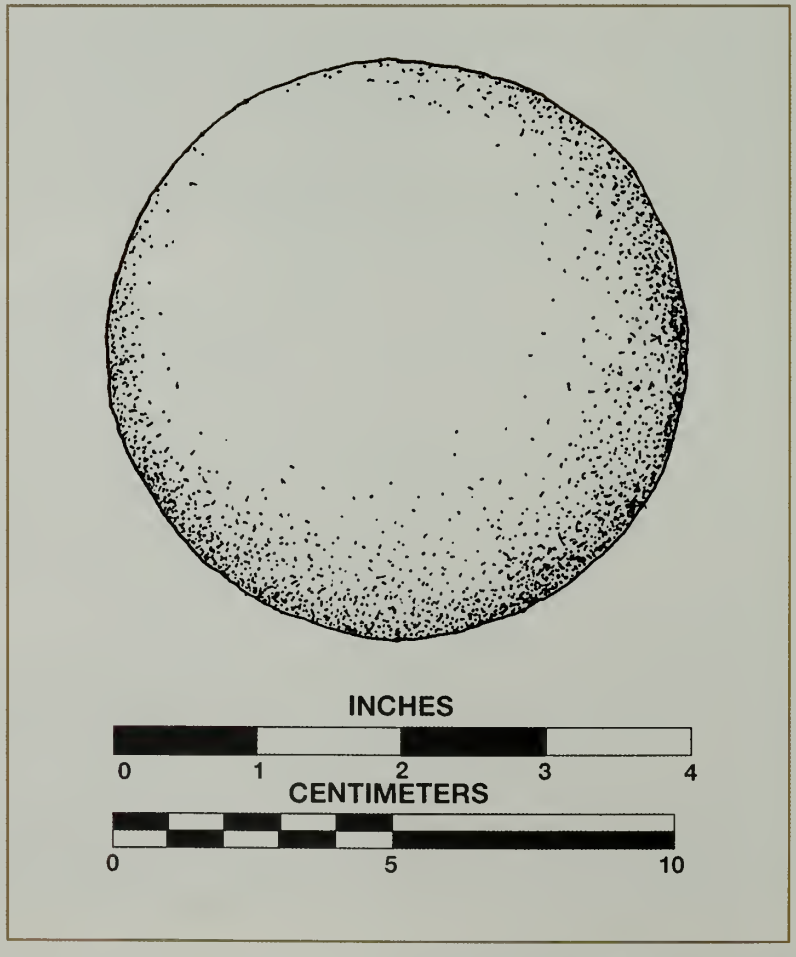


Figure 26 • Smallest iron shot collected by Muir, before conservation (Muir 59).

Figure 27 • Large iron shot collected by Muir (Muir 62).



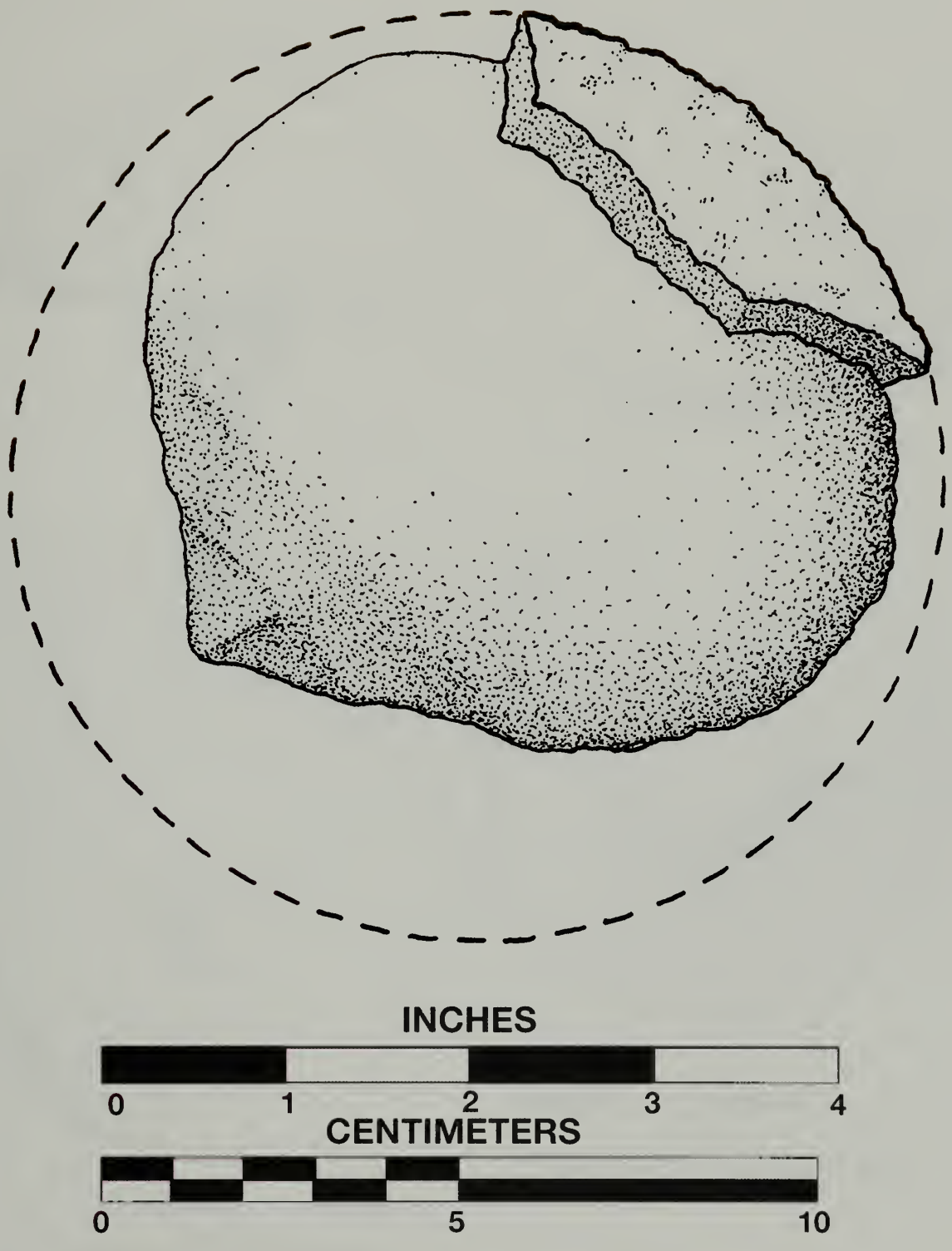


Figure 28 • Largest iron shot collected by Muir (Muir 63).

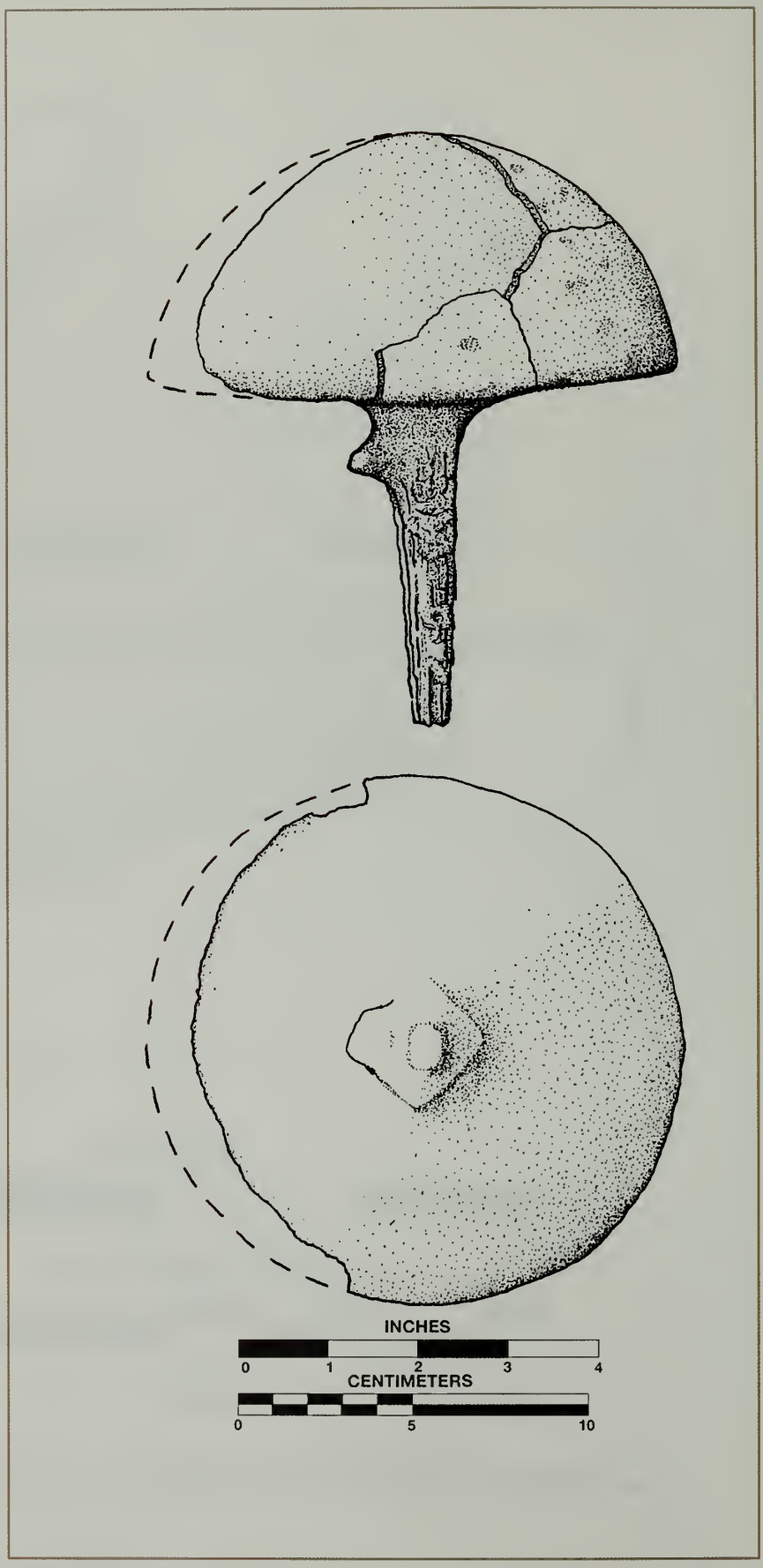


Figure 29 • Fragmentary bar shot collected by Muir (Muir 61A).

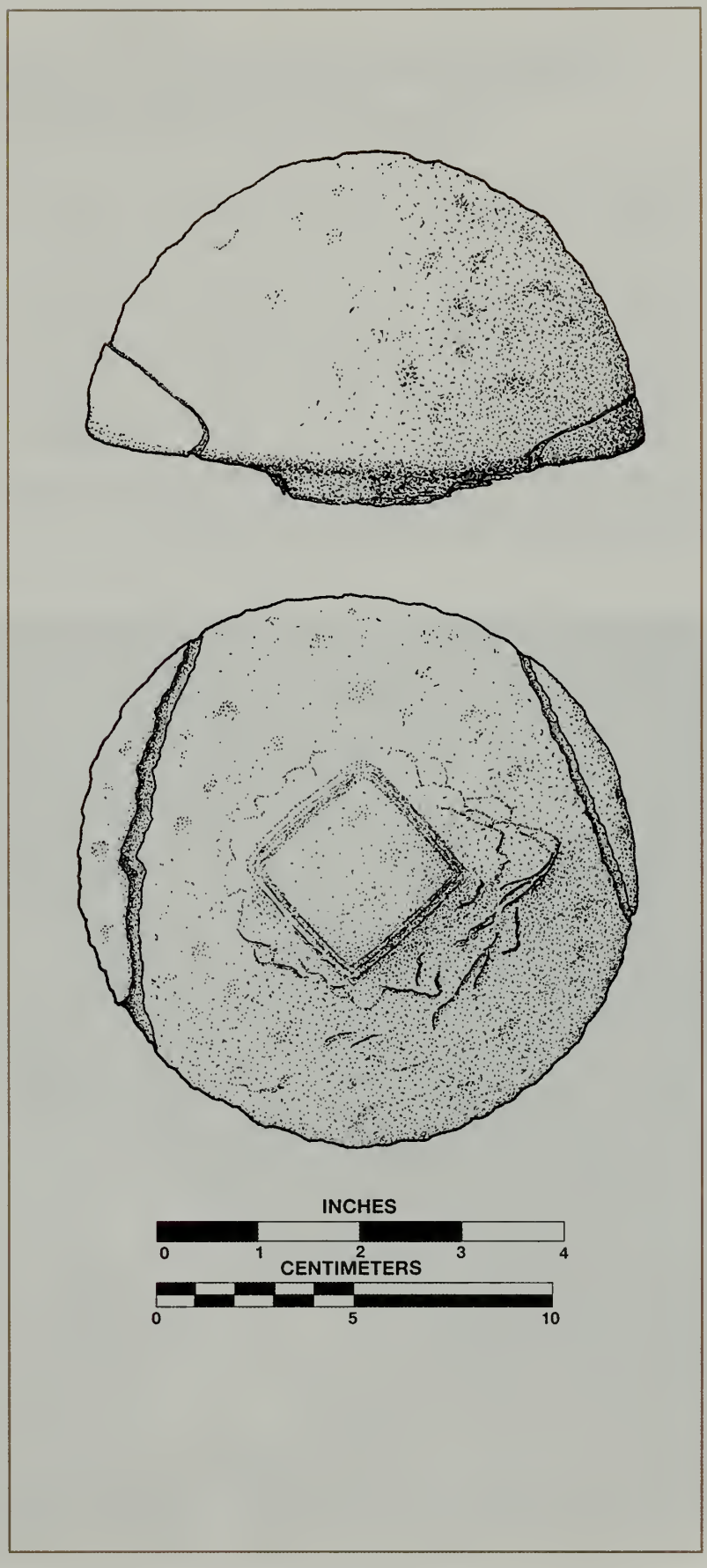


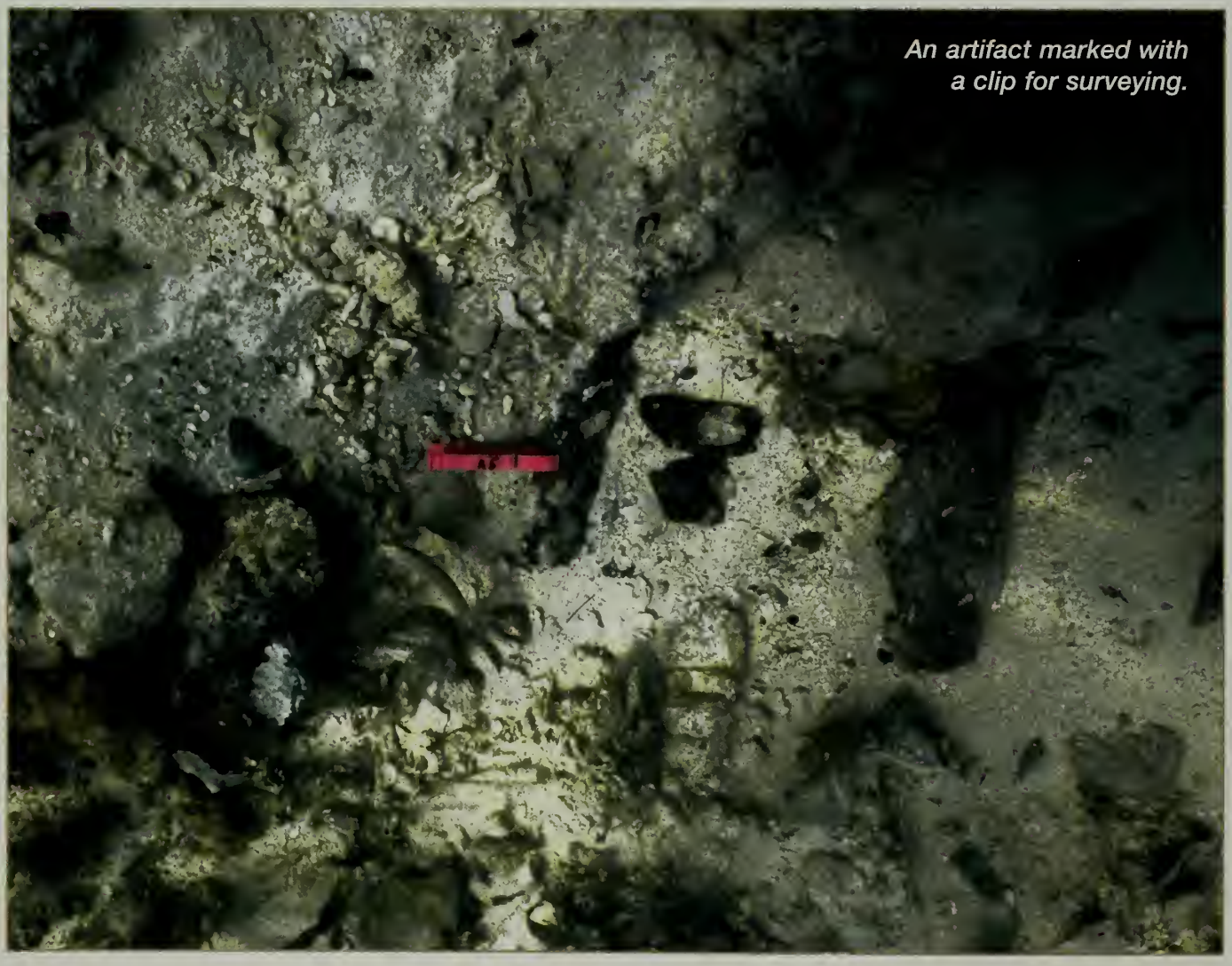
Figure 30 • Fragmentary bar shot collected by Muir (Muir 61B).

TABLE 2

IRON SHOT SIZES FROM BOCA CHICA CHANNEL WRECK COMPARED TO CONTEMPORARY SYSTEMS[1]

Artifact Number	Shot Type	Diameter (cm.)	Diameter (in.)	Caliber (British)	Caliber (French)	Caliber (Spanish)	Weight (lbs.)	Weight (kg.)
Muir 59	Round shot	4.1	1 5/8	1/2-pounder	1/2-livre	1/2-libra	0.3	0.14
Muir 62	Round shot	10.0	3-and- 15/16	9-pounder	8 livres	8 librae	7.1	3.2
Muir 63	Round shot	13.5	5 1/4	18-pounder	16 livres	16 librae	12.9	5.8
Muir 61A	Bar shot end	13.1	5 1/4	18-pounder	16 livres	16 librae	9.4	4.25
Muir 61B	Bar shot end	13.5	5 1/4	18-pounder	16 livres	16 librae	9.6	4.3

[1] Sources for this table include: Michael Phillips, *Cannon and Carronades*, http://www.cronab.co.uk/gen1.htm; Brian Lavery, *The Arming and Fitting of English Ships of War: 1600-1815* (Annapolis: Naval Institute Press, 1987); Robert Wilkinson-Latham, *British Artillery on Land and Sea, 1790-1820* (Devon, England: David and Charles, Ltd., 1973), 26; and Mendel Petersen, *History Under the Sea: A Handbook for Underwater Exploration*(Washington, DC: Smithsonian Institution, 1965), 80, 83.



An artifact marked with a clip for surveying.

The next larger round shot (Muir 62, Figure 27) is in good condition, with a preserved diameter of 3.9 inches (10.0 cm). It may have been designed as an 8- or 9-pounder depending on its nationality.

The surface of the largest round shot (Muir 63, Figure 28) has completely spalled off, but its diameter before spalling was 5.25 inches (13.5 cm). It may be a 15- or 18-pounder depending on the nationality.

Muir 61A and Muir 61B are ends of half-round bar shot. The preserved diameter of Muir 61A (Figure 29) before extensive spalling was 5.25 inches (13.5 cm); the shot has a corroded 4.125 inch (10.5 cm) long portion of the crossbar remaining, 1.4 inches (3.6 cm) square. Muir 61B (Figure 30), with a preserved diameter of 5.125 inches (13.1 cm), is in better condition overall than Muir 3, but has only the faint stump of the crossbar remaining. Muir (1979) noted that these two bar shot ends were found "nestled against each other with ballast stones attached" and believes they were originally a single piece of bar shot.

Cookware and Utensils

Cooking Vessels

Fragments of a Spanish *El Morro* glazed earthenware cooking pot with a handle (97-35, 97-36, and 97-37, Figures 31 and 32) were found in the aft-most excavation unit. The six sherds were reconstructed to form approximately two-thirds of the vessel with a complete profile 6.5 inches (17.0 cm) high. One fragment (97-35) was found adhered to a concretion that included an olive jar fragment (97-35A) and the boom iron (97-35B) discussed earlier. The *El Morro* vessel has an interior glaze color that varies from olive green to red-orange and yellow-orange. The exterior is unglazed. The vessel's walls taper gently inward toward the rim (rim diameter 7.1 inches [18.0 cm]). The rim has a flat, slightly concave lip folded outward to form a flat, vertical edge. The exterior of the vessel is stained black, as is the core of the base area; the handle also has a darker coloration. This blackening may be due to burning during use, or may be post-depositional organic or metal staining. The vessel's vertical, flattened loop handle is coarsely applied and has a central depression; it closely resembles the handle form on a *basín* vessel illustrated in Deagan (1987:49).

Spanish lead-glazed *El Morro* wares generally occur in utilitarian forms. These types were usually wheel-thrown, with hand-molded appendages. This type of earthenware exhibits clearly visible and irregularly compacted temper of quartz sand, with occasional red clay inclusions. The paste color ranges from tan to reddish-buff. Glazing is usually confined to the interior surfaces. The glaze is usually thin, irregular, and transparent and

Figure 31 • Fragments of a Spanish El Morro *earthenware jar with handle (97-35, 97-36, and 97-37).*

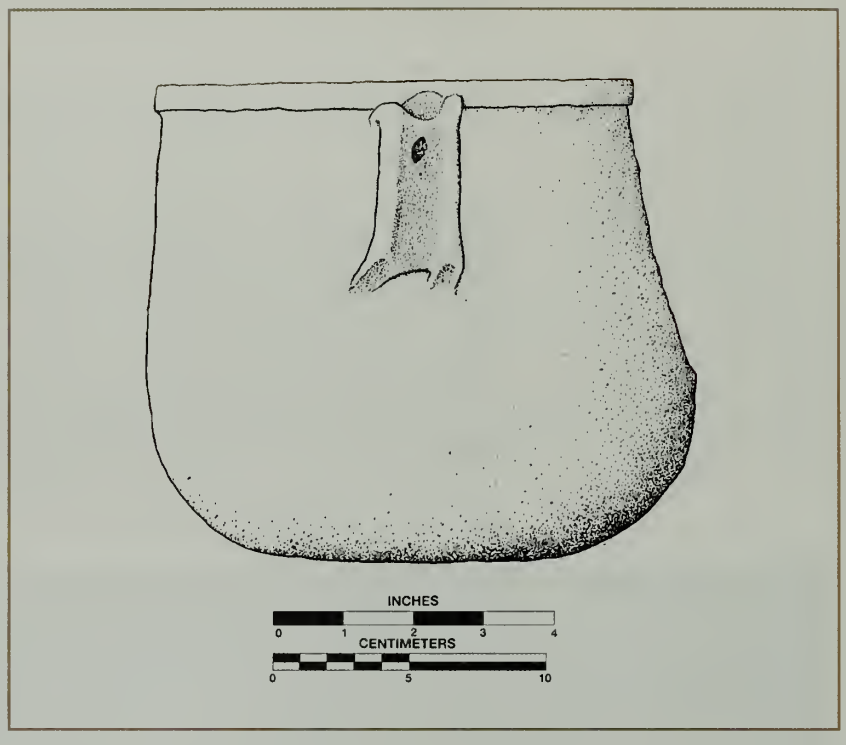
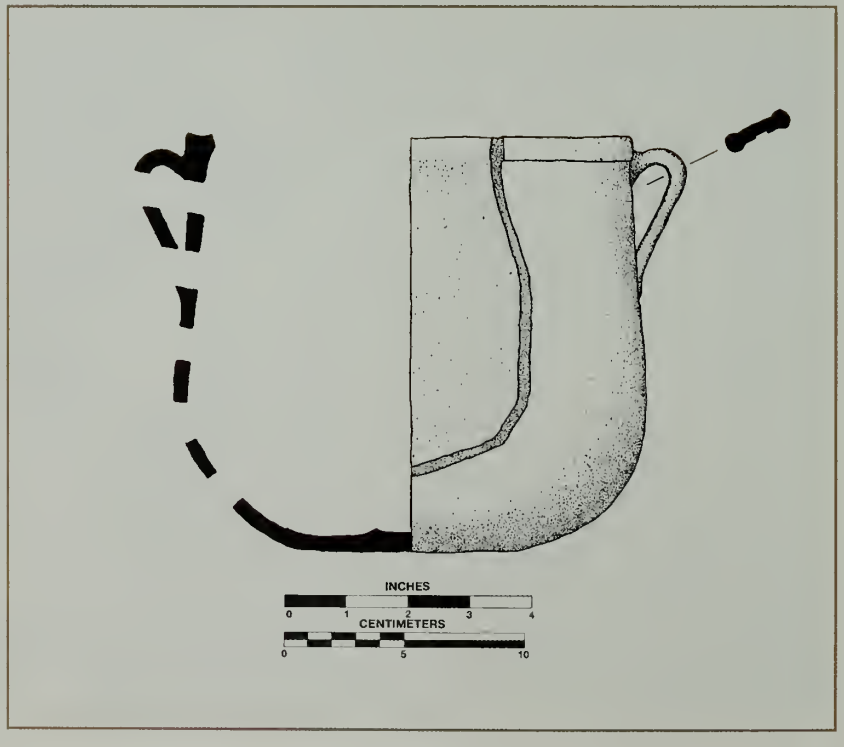


Figure 32 • Fragments of a Spanish El Morro *earthenware jar with handle (97-35, 97-36, and 97-37).*



is orange or olive green, although brown, light green, rust, or mixtures of these colors have been reported. *El Morro* vessel forms include small globular bowls, *basíns* without handles, plates, cups, and pitchers. The date range of *El Morro* earthenware has been established at St. Augustine, Florida, as 1600-1770, although it occurs in the mid-sixteenth century at the colonial sites of El Morro, Cuba, Nueva Cádiz, located off of Venezuela's coast, and Puerto Real located off of Haiti's northern shore (Deagan 1987:50-51).

Tableware

One nearly complete Rouen style blue-on-white faience plate (97-42, Figure 33) was recovered from the forward area of the shipwreck. The glazed surfaces of this artifact are well preserved. This type of ceramic has a date range of 1740 to 1790 (Silvia and Waselkov 1993:132). South (1977:213) explains that the chronology of debased Rouen faience varies between English and French sites in the U.S.; on French sites it dates to 1755, and on English sites to 1775. The plate from the Boca Chica Channel site is 9.5 inches (24 cm) in diameter and 0.24 to 0.32 inches (0.6 to 0.8 cm) thick. The plate is edged with a band of painted decoration that includes the "trellis-and-dot" pattern (blue dots outlined in black diamonds), alternating with a pattern of blue diamonds. Festoons and a floral motif separate the areas of the patterns. The underside of the plate is brown. A rose with stem and leaves is painted in blue in the center of the plate. The paste is reddish brown in color. Brain (1979:44) notes that this paste coloration is generally found only on sites that date after 1750, and that before this time paste was a lighter buff color:

> It is our belief that Rouen style faience with hard orange to reddish-orange paste is later than that with a softer buff or pinkish-buff paste. The evidence for this conclusion is the observation that all of this style of faience from pre-1750 context in the lower Mississippi Valley (e.g. Angola Farm, Fatherland, Haynes Bluff) has the buff paste, while the reddish-orange paste is found only on sites that have components dating into the second half of the 18th century (Brain 1979:44).

The glazed surface of the plate was analyzed by x-ray fluorescence at the laboratory of the Freer Gallery of Art, Smithsonian Institution, Washington, D.C., and was found to have a predominantly lead content with a much smaller content of tin.

A nearly identical Rouen style plate was discovered at Los Adaes, the Spanish presidio, mission, and a capital of Texas, in northwest Louisiana occupied between 1716 and 1773 (Avery 1997:1-4,17). Avery (1997:3) notes "only 35% (weight percentage) of the tin-enameled wares at Los Adaes are Spanish, the remaining 65% are mostly French, with some

Figure 33 • Nearly complete Rouen blue-on-white faience plate (97-42).

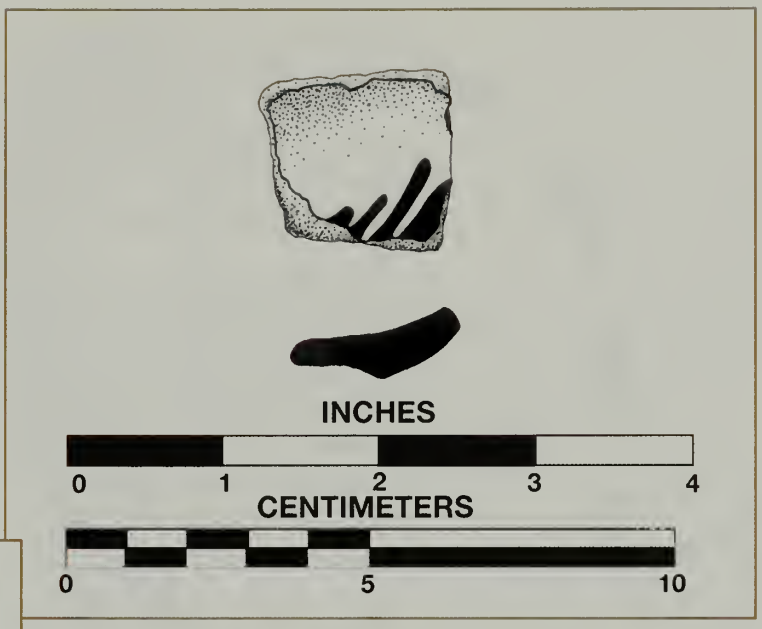
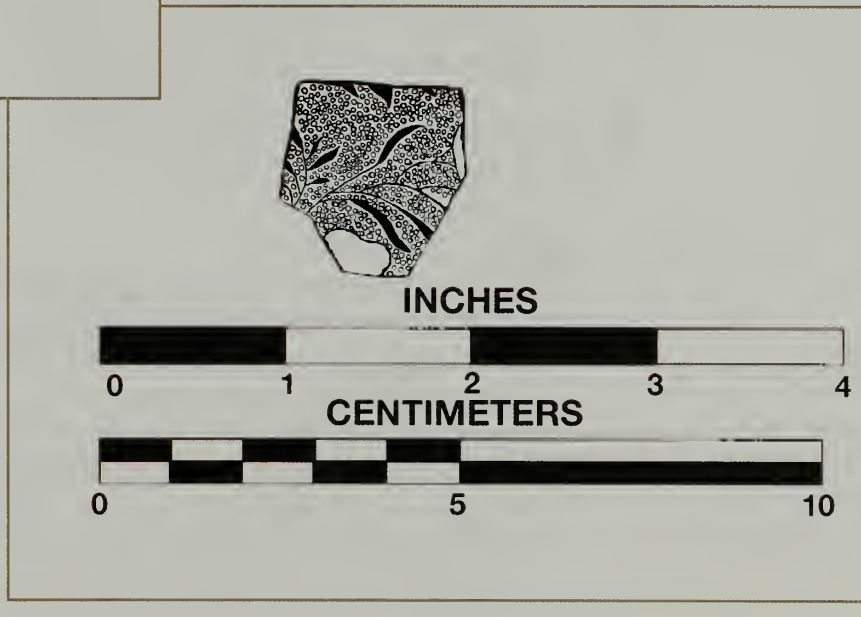


Figure 34 • (Top)
A sherd of blue-on-white tin-glazed earthenware with buff-colored paste (97-44).

Figure 35 • (Left) Body sherd of pale blue-on-white, glazed earthenware with buff paste (97-56).

Figure 36 • (Bottom)
A sherd of transfer-printed pearlware with chinoiserie *characteristics incorporating a blue-on-white floral spray decoration (97-38).*



British and/or Dutch wares." The opposite situation occurred at Old Mobile, the initial French capital of Louisiana from 1702 to 1711, north of present day Mobile, Alabama, where the majority of tin-enameled wares are Spanish colonial (Waselkov 1991:143). These examples illustrate the difficulty of assigning ethnicity based on artifact assemblages from eighteenth-century contexts in the southeastern U.S.

A small, 0.2 inch (0.5 cm) thick sherd of blue-on-white tin-glazed earthenware with buff-colored paste (97-44, Figure 34) was found in the ballast near the mainmast step. The preserved decoration consists of brushstrokes of light blue. This sherd may be Spanish *majolica* as the glaze is thin and without surface pitting. This sherd is nearly identical to another small, thin (0.2 in, 0.5 cm) body sherd of pale blue-on-white, glazed earthenware with buff paste (97-56, Figure 35) also found on the site. It is possible that these two very similar sherds belong to the same vessel.

Another small glazed sherd (97-38, Figure 36) was recovered during the 1997 season. Its convex surface has *chinoiserie* characteristics incorporating a blue-on-white floral spray decoration. It is an example of transfer-printed pearlware dating to the second half of the eighteenth century (Hume 1977:49-50). Other examples bearing similar characteristics were recovered from a Plymouth Plantation, Massachusetts, trash pit dating to 1760 (Deetz 1972:31), and the John Hicks site in St. Mary's City, Maryland. (Stone *et al.* 1973:113).

Storage Containers

Olive Jars

A large sherd representing approximately one-third of an olive jar (97-06, Figure 37) was recovered from the port side of the wreck forward of the main trench. The surfaces were encrusted with the remains of coralline algae and the skeleton of an inshore, hard coral (*Favia fragum*), suggesting that the sherd had been exposed for some time. Two smaller, thinner sherds were found nearby and may represent another ceramic vessel. The large sherd preserves a profile from above the base to the upper shoulder. Its paste is orange-red in color and wall thickness varies from 0.4 to 0.6 inches (1.0 to 1.5 cm). Throwing marks and finger marks are visible in the sherd, as are several irregular, thickened areas that appear to be the result of air bubbles trapped in the clay during manufacture. Based on the limited portion of the vessel present, lacking the more diagnostic rim section, the elongated shape appears to be most similar to the Type A Spanish (*botijas peruleras*) examples illustrated for the seventeenth and eighteenth centuries by Marken (1994:120,132). In his description of seventeenth-century vessels of this type, Marken (1994:133) notes, "clay preparation was often inadequate, with jars frequently revealing bubbles and deformities." The sherd is unglazed, with

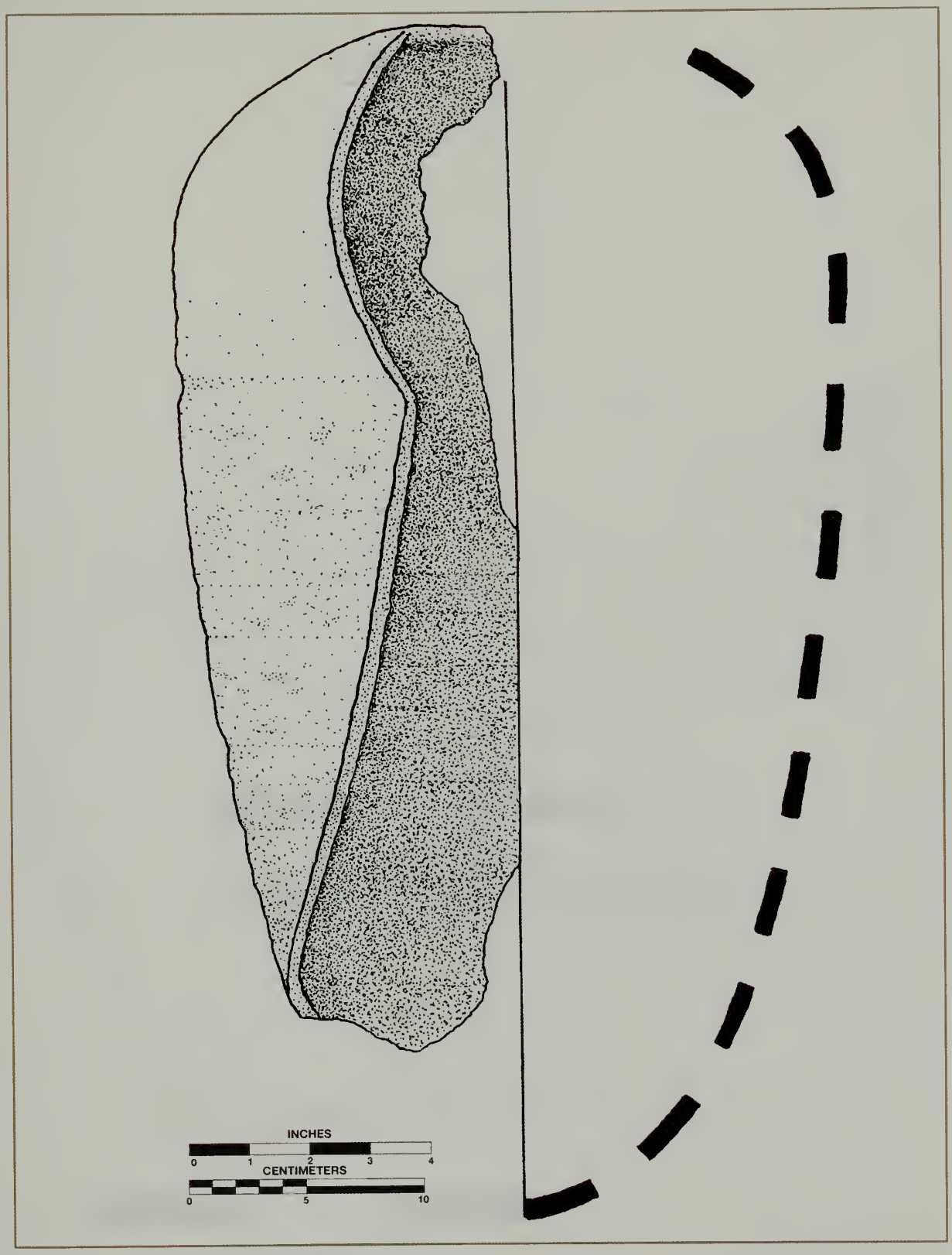


Figure 37 • Large coarseware sherd, probably one-third of an olive jar (97-06).

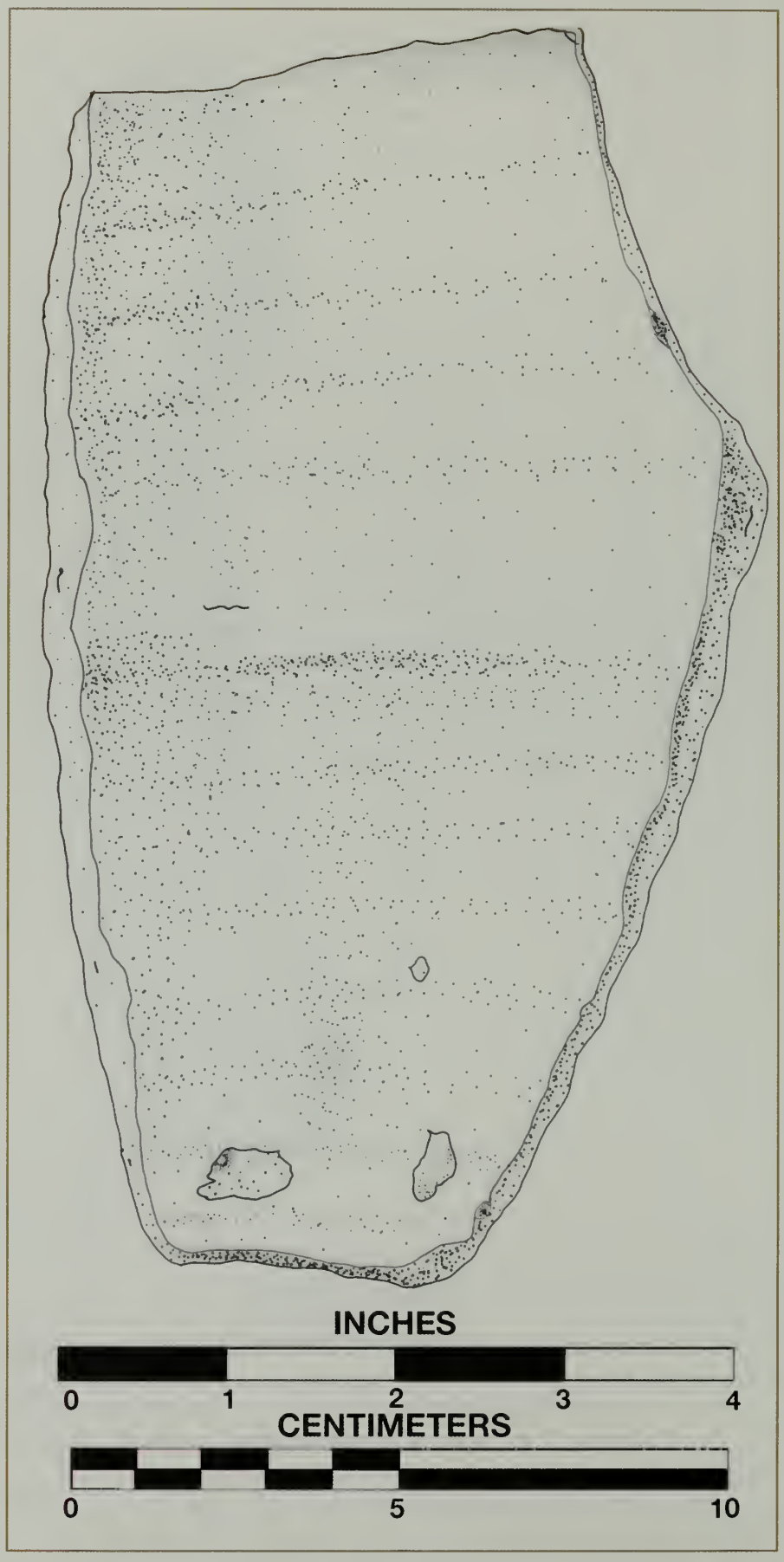


Figure 38 • Large non-diagnostic body sherd (97-09).

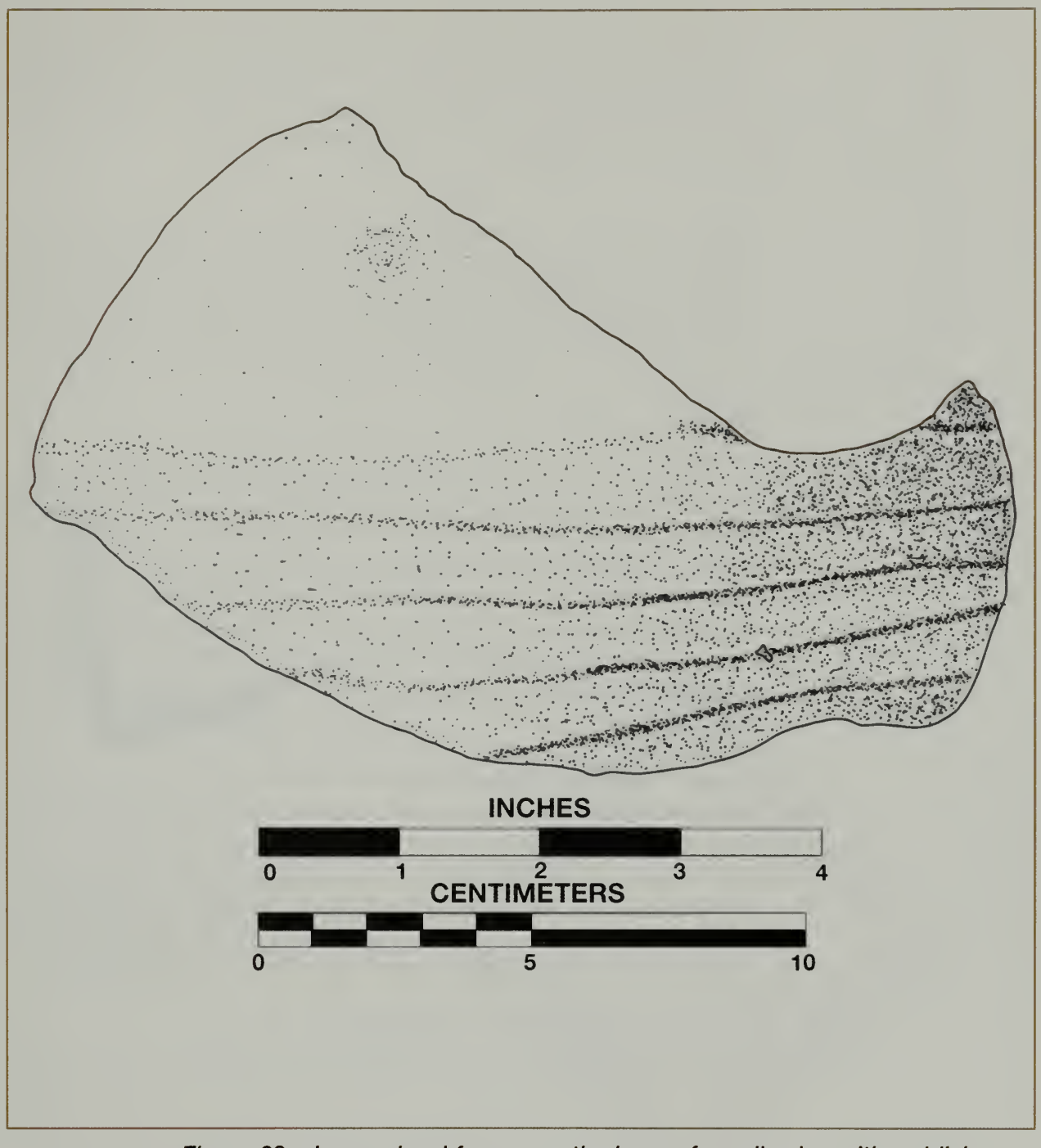


Figure 39 • Large sherd from near the base of an olive jar, with reddish paste and heavy ridges (97-39).

no intentional marks or traces of any asphaltum-like lining material. At least three types of middle-style olive jars were in the artifact assemblage on the 1766 shipwreck of *El Nuevo Constante* (Pearson and Hoffman 1995:166-167). One of these types appears similar to an intact Boca Chica Channel Wreck olive jar reportedly recovered by a Navy chief and later drawn by Muir.

Other olive jar (coarse earthenware) fragments excavated include one large non-diagnostic body sherd with a grey-brown core (97-09, Figure 38), and a large, evenly-fired sherd from near the base of an olive jar (97-39 Figure 39); both have reddish paste, large temper, and heavy ridges. These also appear to have been from vessels with elongated shapes.

Bottles

The square, concave base of an olive green glass bottle with a rough pontil mark and many trapped air bubbles (97-05, Figure 40) was recovered from the wreck's starboard side. It was observed on top of the ballast during the preliminary survey. Bottles of this type, also referred to as case or gin bottles, often had threaded pewter closures, and have been recovered on sites dating from the 1622 wreck of the *Nuestra Señora de Atocha* through the end of the eighteenth century (Deagan 1987:132-133). Muir also recovered an almost identical bottle base (Muir 51) during one of his surveys.

A large, blue glass fragment 0.06 to 0.2 inches (0.15 to 0.5 cm) thick with many trapped air bubbles (97-47, Figure 41) may represent the base of a demi-john bottle similar to that shown by Deagan (1987:132). The capacity of demi-johns ranged between two and 15 gallons; the Boca Chica Channel Wreck example is too fragmentary to allow a determination of its original size. These large bottles often were seated in protective wickerwork, but this material rarely survives in the archaeological record.

The base of a finely crafted, small, green glass bottle (97-26A, Figure 42) was also recovered. The sides taper toward the base. The preserved height is 1.6 inches (4.1 cm). The base exterior is flat with a slight central concavity; the base interior is strongly convex. Very few bubbles are visible in the glass. This bottle may represent a pharmaceutical jar.

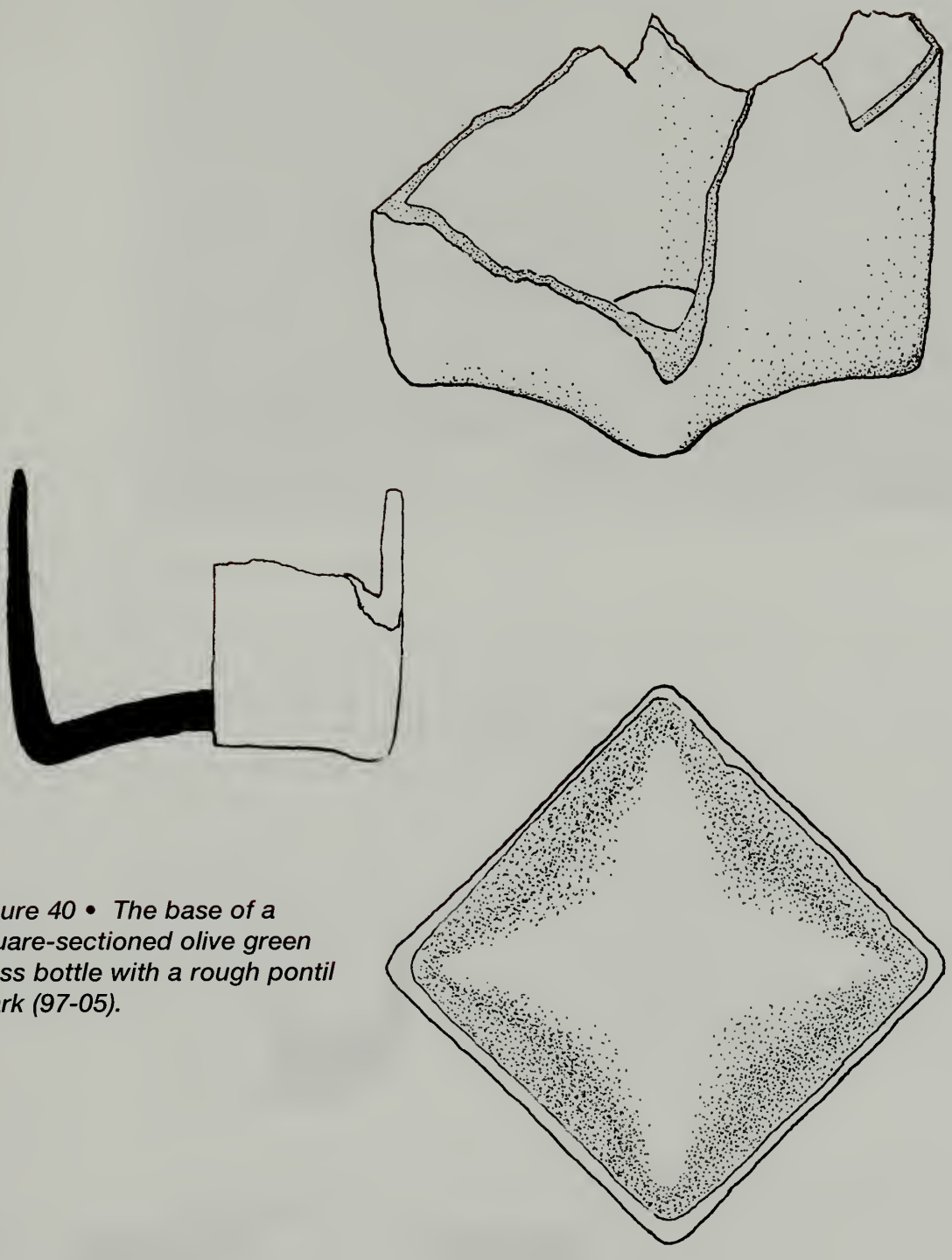


Figure 40 • The base of a square-sectioned olive green glass bottle with a rough pontil mark (97-05).

Figure 41 • A large blue glass fragment that may represent the base of a demi-john bottle (97-47).

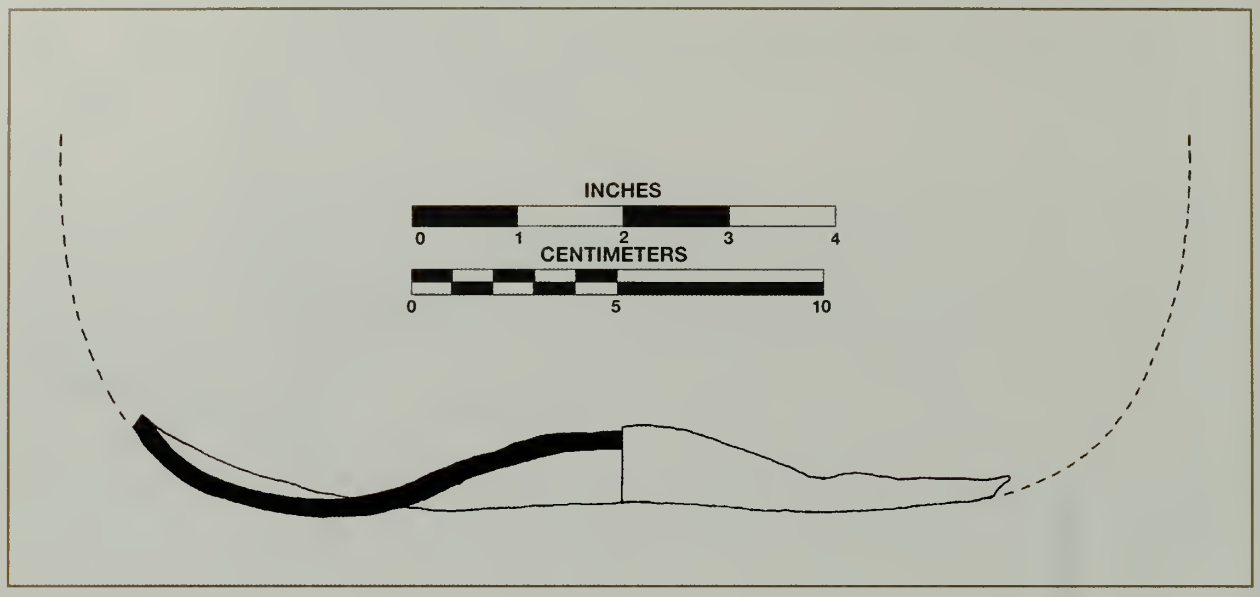
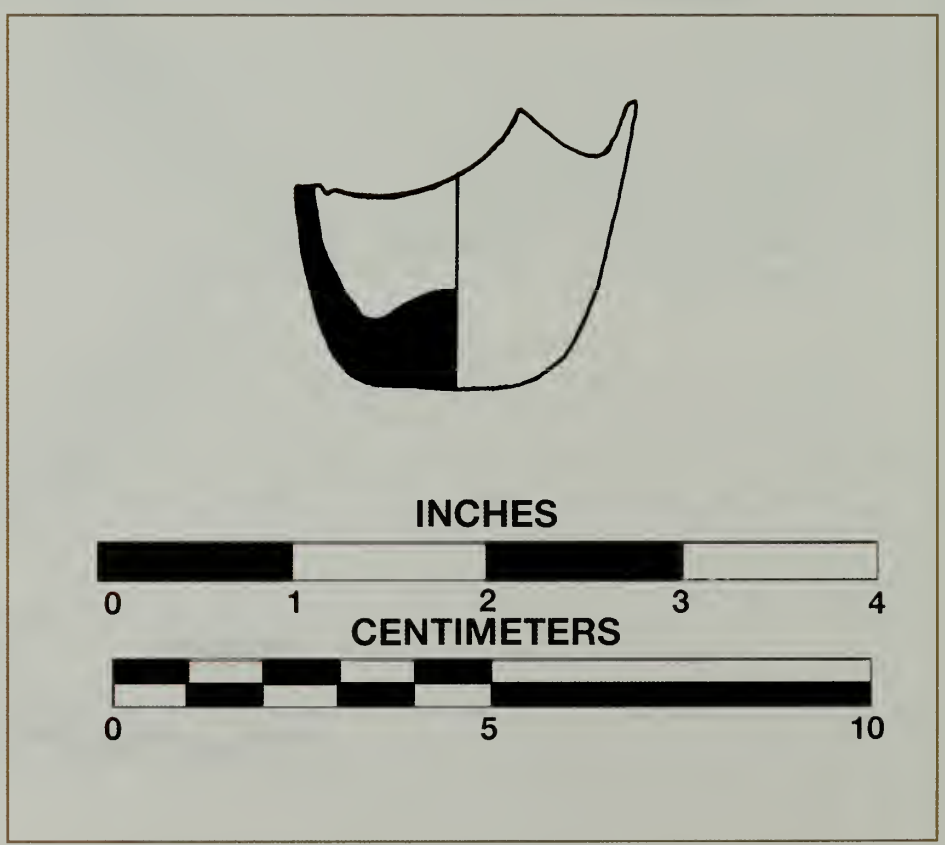


Figure 42 • The base of a finely crafted, small pale green glass bottle (97-26A).



KC Smith maps the keelson's forward extent.

Fishing Weights

Six lead fishing weights were excavated from the site in 1997 (97-08, 97-46, and 97-65, Figure 43). They range in weight from 1.4 oz to 3.7 oz (40.0 g to 106.0 g). Three modern weights with a faceted teardrop shape and an eyelet at the top are intrusive to the wreck site. Three sphendonoid or barrel-shaped weights with a central longitudinal hole may be contemporary with the wreck. The uniform size and shape of each of these weights would seem to indicate modern manufacture, but the poor casting of one of them, 97-08, might argue against a recent age. No parallels from eighteenth-century sites were located during research but similar weights have been observed on seventeenth-century wrecks in the Netherlands (Neyland 1996b:88). Spherical lead weights with a central hole were used by the Dutch for hand lines in the eighteenth century. Oval forms like these could have been used for hand lines but they may also have been used as net weights attached along the bottom or "lead line" of the net.

One flat, oval piece of limestone that may be a fishing-net weight (97-62, Figure 44), weighing 6.9 ounces (195.2 g), was recovered near the mainmast step. Stone net weights are common finds on medieval and late-medieval shipwreck sites in the Netherlands and elsewhere in Europe (Neyland 1996b:88), and are usually intrusive as a result of nets snagging on the wrecks. During the seventeenth century in the Netherlands, these fishing net stones were replaced by lead weights. Most often these intrusions are found near the stem and sternpost, the most prominent portions of the wreckage upon which nets might snag. Because the stone weight was found among the ballast stones amidships, it is possible that it had been collected and included with the ballast.

Figure 43 • Six lead fishing weights (97-08, 97-46, and 97-65).

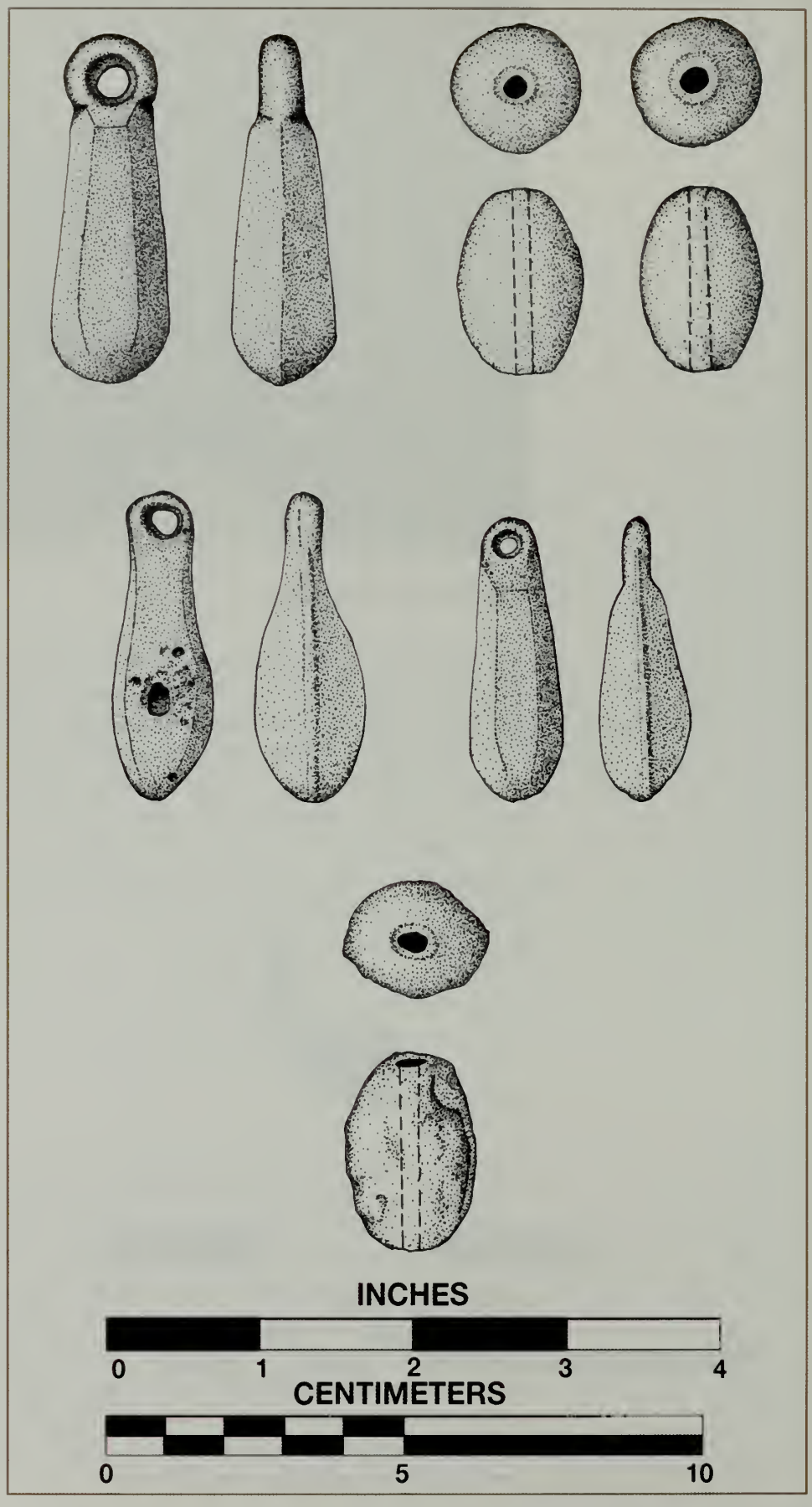
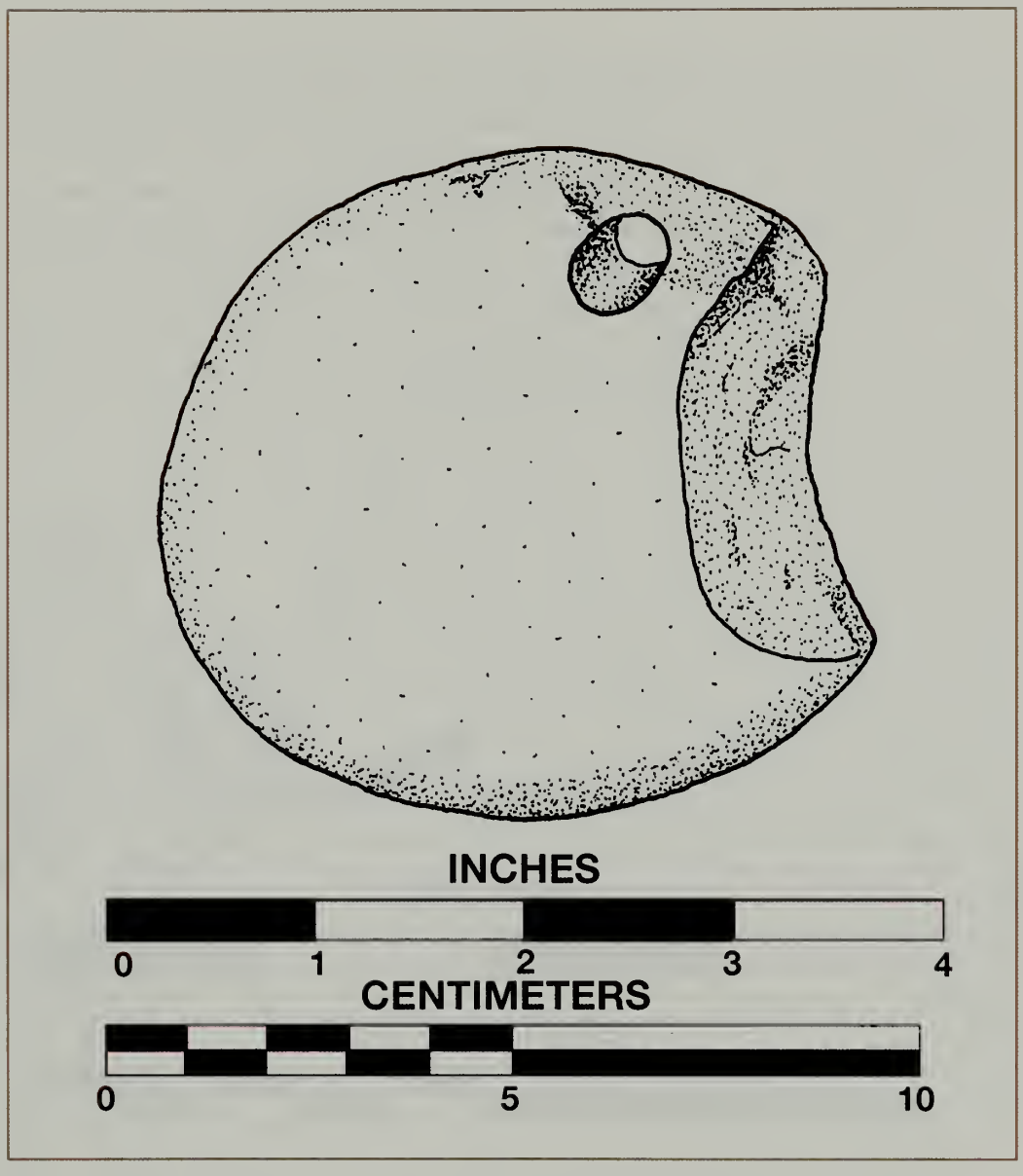


Figure 44 • Possible limestone fishing-net weight (97-62).



Tools and Implements

Scissors

Muir collected a concretion containing the mold of a pair of iron scissors (Muir 54, Figure 45); the tip of the blades and part of the larger loop are missing. Although it appears that the vast majority of eighteenth-century scissors were of a fairly fine type with single-finger, bilaterally symmetrical loops (Hume 1969:267-269), the example recovered from the Boca Chica Channel Wreck appears to be fairly robust with a large single-finger loop and a two-finger loop. Scissors and shears are both terms used to describe this robust type. A close parallel to this artifact was excavated from the mid-eighteenth-century site at Fort Michilimackinac in Michigan (Stone 1974:160-161). Twenty-four of the 27 scissors or scissor fragments recovered at Michilimackinac were steel.

Figure 45 • A pair of heavily-concreted scissors collected by Muir (Muir 54).

Navigation and Measuring Devices

Sandglass

A globe from a sandglass (97-23, Figure 46) was recovered from the wreck's stern area. It is either the upper or lower globe of a 14- or 28-second glass, possibly used for measuring the ship's speed in conjunction with a log line. A sandglass of similar size but more rounded shape, was recovered from the 1758 wreck of *Invincible* (Bingeman 1985:194).

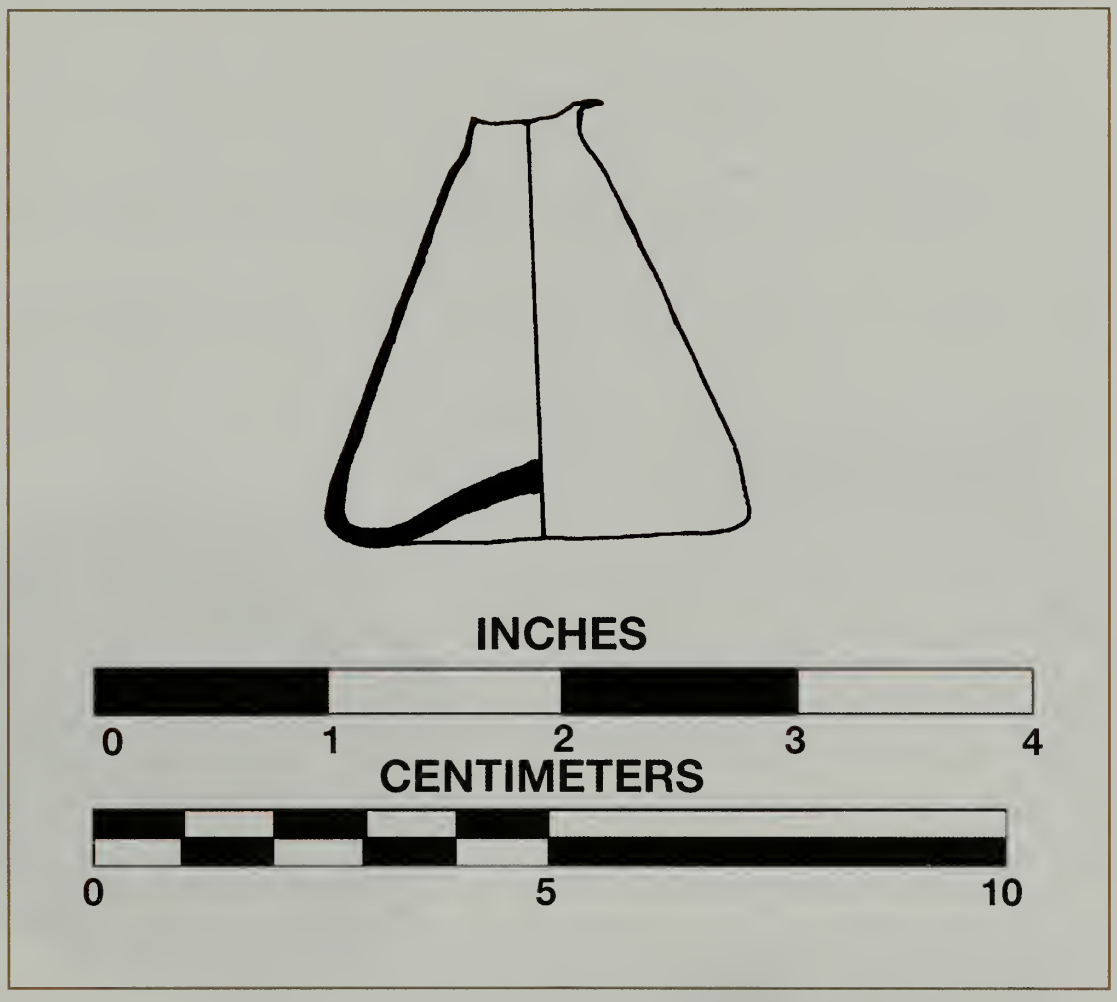


Figure 46 • A globe from a sandglass (97-23).

Coinage

One heavily-corroded silver coin (97-27C, Figure 47) was found concreted to a lead musket ball and iron nail in the stern area of the wreck near the sand glass, *El Morro* ware cooking pot, and lead shot. A small amount of green corrosion on the coin indicated it had a copper content. X-ray fluorescence analysis at the laboratory of the Freer Gallery of Art, Smithsonian Institution, showed the coin to be silver with small amounts of copper, zinc, and possibly strontium. Its weight before conservation was 1.06 oz (30.3 g), and after removal of concretion and corrosion products was 0.37 oz (10.6 g). It was identified by Dr. Richard Doty, Curator of Numismatics for the Smithsonian Institution, as a Mexican dollar, "Piece of Eight," or *ocho real* minted in Mexico City from 1772 to 1789 during the reign of Carlos III. On the obverse of the coin, part of the head of Carlos III and the letters "L'S III" are visible. On the reverse, the central coat of arms design and part of the crown above it are preserved. A similar coin from the Smithsonian's mint collection weighs 0.949 oz (26.972 g) (Doty to Goldberg 1999).

The coin provides a clear *terminus post quem* of 1772 for the wreck. It

Figure 47 • Reverse side of the Boca Chica Channel Wreck silver coin (97-27C).

Figure 48 • The obverse and reverse of an ocho real *coin minted during the reign of Carlos III.*

cannot provide a *terminus ante quem* however, as it may have been in circulation for some time before being lost on the ship. According to Doty, this coin would have been considered legal tender in the U.S. until 1857. According to Peterson (1965:73), gold and silver coins minted in Spanish America "enjoyed the widest circulation of any coinage in history" and were standard coins of international commerce. It would, therefore, be unwise to use this single coin as an indicator of the ship's nationality.

Construction Materials

Bricks and tiles

Several unglazed terracotta tile fragments were found in the excavated areas; two were raised for identification. One is a flat tile (97-13, Figure 49) with orange-red fabric and two squared edges. The other possible tile (97-16, Figure 50) has soft, light grey-brown fabric, worn, rounded edges, and a triangular clay protrusion on one edge that may be the remains of a rim or foot. These may be fragments of the relatively thin unglazed tiles known as *pantiles* or *azoteas* that were used to construct flat roofs in the Caribbean, beginning in the sixteenth century (Deagan 1987:125). These tiles may have been part of the ballast, as they were not recovered from elsewhere on the site. Another possibility is that they were used as part of the ship's hearth; however, no burn marks were noticed on the tiles.

One red brick fragment (97-51, Figure 51) was recovered from the wreck site. This is not a fragment from a standard brick; rather, it is from a flat brick suitable for paving and a variety of other uses. The only remaining original dimension is the brick's 1.25 inch (3 cm) thickness. This item may have been associated with the wreck as ballast or as part of the ship's hearth, or it may be intrusive to the site.

Intrusive Artifacts

Ceramics

The collection includes a single sherd of tan-glazed stoneware (97-45) probably dating from the late nineteenth to the early twentieth century, and a complete, shallow, open-brimmed whiteware bowl (97-43). A maker's mark on the base of the bowl consists of a cross on top of a crown surrounded by a wreath, with the words "WARRANTED B" below. This piece was produced in Baltimore, Maryland, by the Bennet Pottery Company between 1856 and 1890 (Kovel and Kovel 1953:206). A fragment of a shallow, brimmed, whiteware bowl with a scalloped rim (97-31) was also found. The maker's mark reads "CLINCHFIELD CHINA" and "S.P.I." enclosed by a circle with a stylized crown on top and "12.20" below. This ware was a product of Clinchfield Pottery, an enterprise

Figure 49 • Flat tile (97-13).

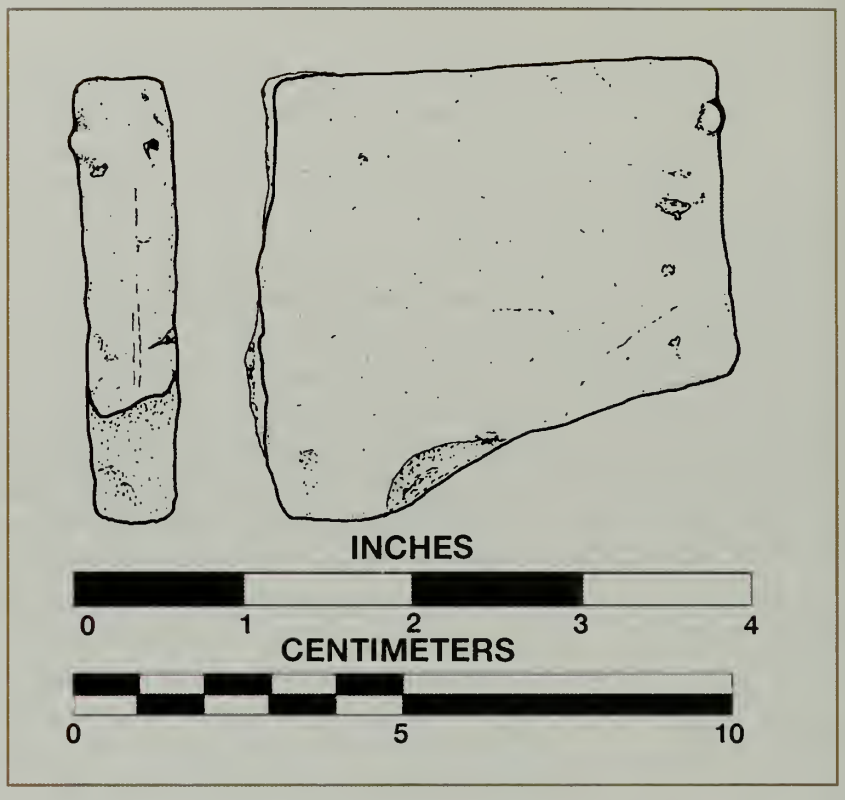


Figure 50 • Tile with a foot (97-16).

Figure 51 • One broken red brick (97-51).

formed by the Carolina, Clinchfield, and Ohio Railroad to help increase traffic along the railroad. The pottery was renamed Southern around 1917 (Lehner 1988:433).

Another whiteware bowl fragment (97-25) has a maker's mark consisting of a *fleur-de-lis* within a circle surrounded by "IMPERIAL PORCELAIN WARRANTED," and enclosed by a larger circle with a crown on top. The rim interior has a scrolled molded relief design. This pottery was produced in Wheeling, West Virginia, by the Wheeling Pottery Company established in 1879 (Kovel and Kovel 1953:170).

Another whiteware bowl in fragments (97-11, 97-24) is decorated with a blue transfer-print motif of floral sprays with delicate leaves and flowers. The maker's mark on the base is composed of a crown enclosed by a wreath. The maker's mark indicates that this bowl originated from the Bennett Pottery Company, which was established in Baltimore, Maryland, in 1840 (Kovel 1953:205).

The collection also includes a blue transfer-printed, shallow-brimmed whiteware plate with a scalloped rim (97-30). The Chinese-style pattern is known as "Willow" and was produced from the late eighteenth century to the turn of the twentieth century (Sussman 1979:235). A symbol that looks like the letter "A" is preserved on the base.

Glass

An olive green glass bottle base (97-58) with a high, smooth kick-up, and an olive green bottle neck and shoulder (97-55) recovered from the shipwreck probably date to the nineteenth or twentieth centuries. Muir also recovered a cobalt blue goblet (Muir 67) that most likely dates to the first quarter of the twentieth century.

Plastic Bead

Muir collected a blue bead bearing a close resemblance to faceted glass, garnet, and jet beads found on seventeenth- and eighteenth-century Spanish wreck sites (Muir 68). After cleaning in the conservation laboratory, it was determined that this artifact was plastic and therefore modern.

Tableware

Muir collected a four-tined fork (Muir 66) from the site. The surface of the fork apparently deteriorated after excavation, but Muir provided a description of the fork as found (Muir 1991:9):

> One gilded silver four tine fork, condition fair, pitted sur-

face, tines intact except thin at several places, gilding originally visible at portions of handle and along parts of the tines, indicating total gilding in original state. Decorative vine pattern on handle is damaged by pitting, but an ornate sweeping letter 'R' was originally visible at end of handle, with the lower case 'X' about midway down the handle. The letters could merely be a part of the entwined vine pattern however. Pitting damage made this difficult to assess. It is similar to forks recovered from the 1715 and 1733 [Spanish wreck] sites, but also is equally similar to turn of the century forks. It was found cemented by conglomerate to a ballast clump.

As received in the NHC conservation laboratory, the fork had a very different appearance. It had no surface detail preserved, and was covered in green corrosion products. It had a silvery appearance in areas, and thus appeared to be a silver-copper alloy, or perhaps silver-plated over a copper alloy base, but there was no evidence of gilding. X-ray fluorescence (XRF) analysis at the Naval Research Laboratory, Washington, D.C., showed the fork to be a copper-nickel alloy; no silver or gold was identified. A small peak corresponding to chromium was identified, indicating the fork is probably a more modern intrusion. The gilding noted by Muir may have been due to copper sulfide layers, which can appear golden and iridescent.

Miscellaneous Objects

A grey metal plate with a cutout-style design of the letters "..LORIDA" and a palm tree, and the molded inscription "LAND OF SUNSHINE," may be an automobile license plate frame (97-77). It is probably made of chromed pot metal and likely dates to the first quarter of the twentieth century when an automobile bridge was located near the site. Artifacts observed on the site but not recovered include concretions that appear to be a rear car axle, a wheel from an automobile, and a large piece of boilerplate.

Unidentified Objects

In 1997 a small 0.6 inch (1.4 cm) diameter copper alloy object that may be a button core or tack head (97-22A, Figure 52) was recovered from the wreck. The state of preservation of this artifact is very poor and there are no discernable diagnostic features. The raised area in the middle of one face of the object may be the corroded location for an eye through which a button could be fastened to fabric or the remnant of a tack shaft.

A metal cylinder and a lid-like object recovered from the site by Muir in

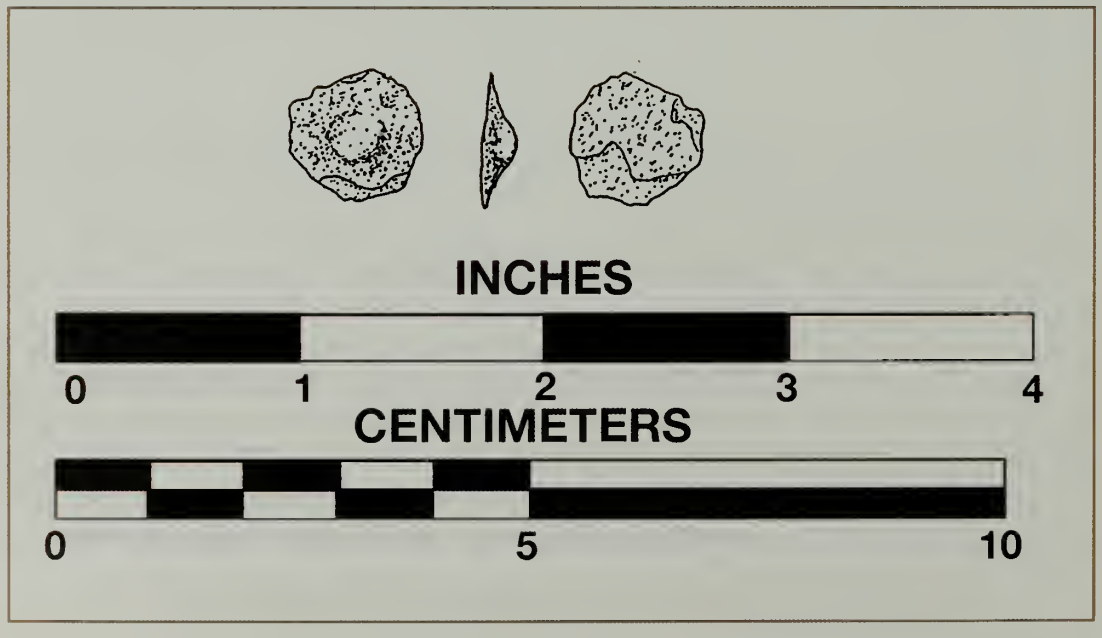
the 1980s have proven to be puzzling (Muir 69A,B Figures 53 and 54). Both are made of thin copper or copper alloy.

The slightly crushed cylindrical object consists of an outer tube with a smaller perforated tube inside. One end of the outer tube is closed and the inner tube is attached to and runs through this thick plugged end. The opposite, open end of the outer tube has two sets of tiny holes piercing the circumference of the rim. These appear to have been fastener holes for a missing end cap, end plug, or other attachment. The same end of the inner tube has a small, short cylinder that appears to be threaded into it.

The lid-like object is a domed disc that looks like it should be the missing end of the copper cylinder because both objects appear to be made of the same material and have a similar corrosion patina. However, the 2.6 inch (6.5 cm) diameter of the disk is too large to fit to the end of the cylindrical object, which has an estimated original diameter of 2.0 inch (5.0 cm). Also, the domed disk does not have fasteners or fastener holes to correspond to the holes on the cylindrical object.

No positive identification has been made of these objects. Suggestions include: part of a small pump for a small boat; part of a pump of the type used to pump liquids from barrels in the hold of a ship, such as Truscott's pump circa 1812 (Lavery 1987:191); a trimming rod float such

Figure 52 • A small copper alloy metal object (97-22A).



as those used for a short time in English ships of war during the late 1700s (Lavery 1987:188); a medical syringe for enemas or to drain boils and other lesions; a coffee mill; a powder measure; part of a steam engine; or an intrusive muffler. Analysis of the metal may help to identify it as contemporary with the shipwreck or modern.

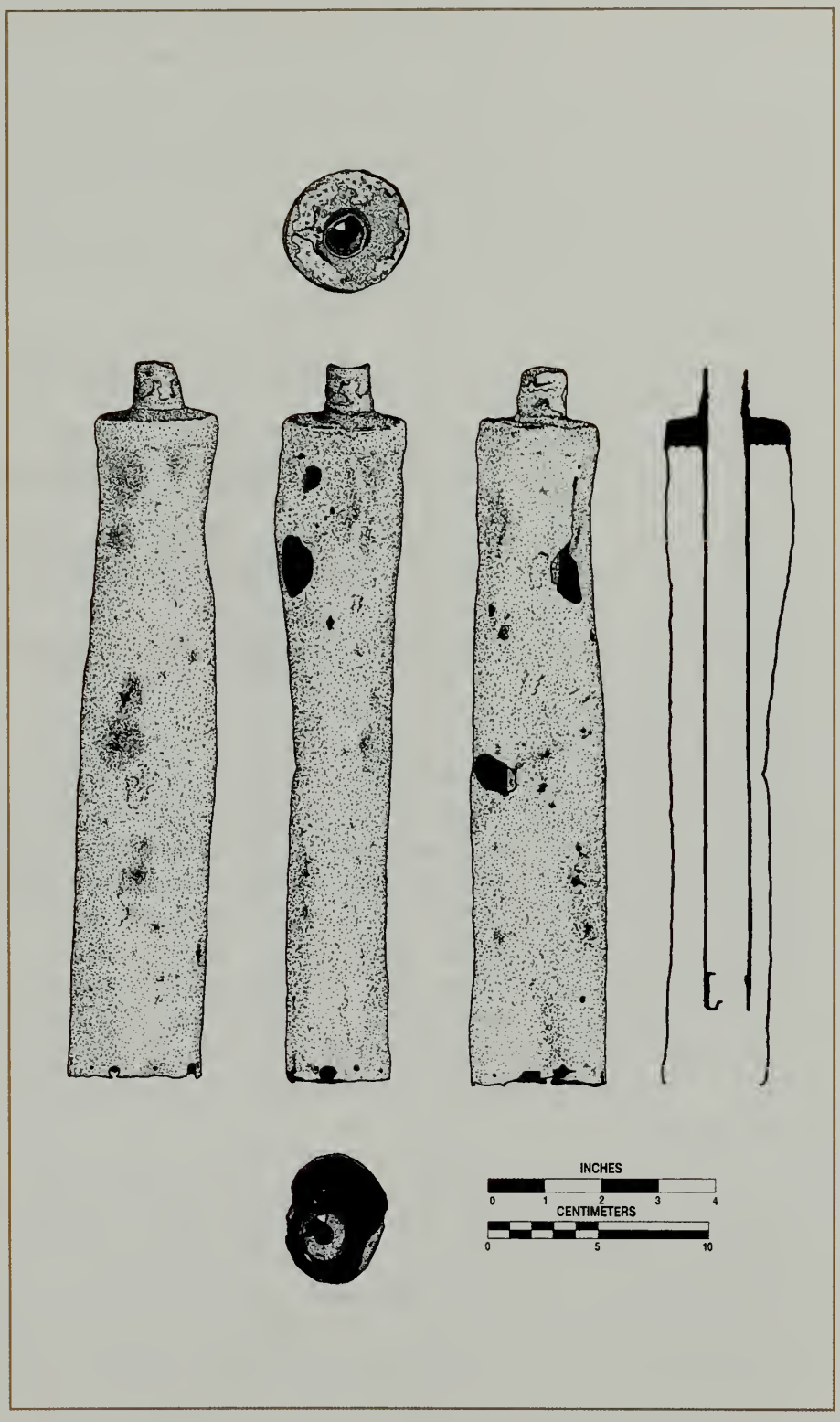
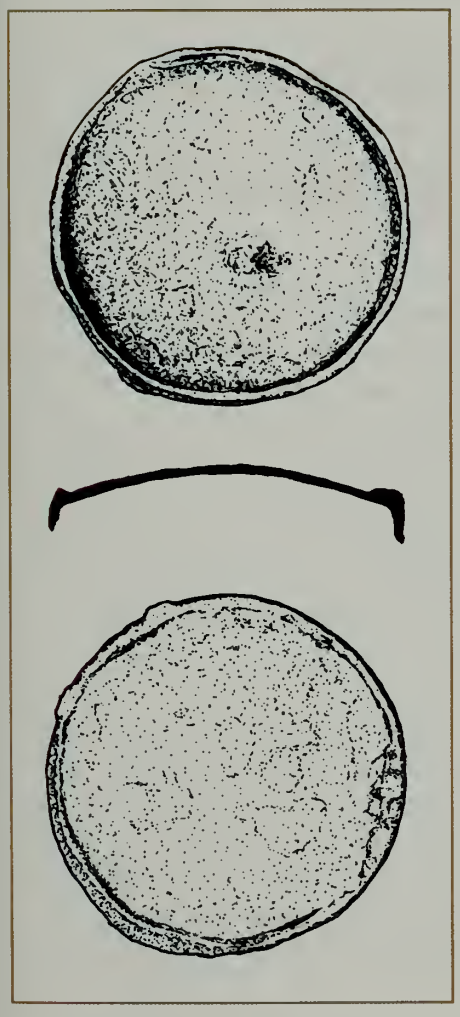


Figure 53 • (right) A metal cylinder (Muir 69A).

Figure 54 • (bottom) A lid-like object (Muir 69B).



Chapter Eight Analysis and Conclusions

The Boca Chica Channel Wreck represents a small vessel from the second half of the eighteenth century. The ceramics and Rupert shot indicate a time period ranging from 1740 to 1790. The Spanish *ocho real* coin dating to the reign of Carlos III was of a type minted in Mexico City from 1772 to 1788 giving a *terminus post quem* of 1772 for the sinking of the vessel. Hence, the artifacts indicate that the ship sank sometime between 1772 and 1790 (Table 3). It is of course possible that the ship could have been in use before and after this time period. It is also interesting that this time period coincides with that of the American Revolution, at a time when Britain, the American colonies, France and, by 1779, Spain were all at war. Historic records indicate that the Lower Keys were used by both the Spanish and British Bahamians during the second half of the eighteenth century. Although the survey was unable to determine the ethnicity of the ship's crew with certainty, the predominance of French and Spanish ceramics makes one of these nationalities more likely than British. Kaolin tobacco pipes, which are common on British sites, are absent from the artifact assemblage collected. However, no artifacts were recovered that could be defined as personal possessions, other than the coin. Other areas of the wreck site might yield personal possessions, which might be more indicative of ethnicity.

Table 3

ARTIFACT DATE RANGES

Rupert Shot	**1665-1769**
El Morro Ware	**1500-1770**
Rouen Faience	**1750-1800**
Tin-Glazed Ceramic	**1750-1800**
Case Bottle	**1600-1800**
Olive Jar	**1500-1800**
Coin	**1772- +**

The transverse mast step, although at first appearing to be an evolution from the earlier Spanish buttress mast steps, seems to be a transition in eighteenth-century shipbuilding common among several nations. The use of lead strips for caulking and repairs is known from Mediterranean shipwrecks and Spanish wrecks and may be an indication of that heritage. The use of Spanish cedar, which grows primarily in the West Indies, Mexico, and Central America, indicates New World construction and perhaps evidence of Caribbean origin.

The wreck appears to be that of a small sailing vessel, certainly under 100 feet in length and probably 60 feet or less. The overall extent of the wreckage and the small dimensions of the frames and timbers indicate a small craft. It was probably a single-masted vessel, such as a sloop.

The ship's purpose remains unknown without further archaeological and historical information. Historical records for the Florida Keys during the late eighteenth century are limited because the Keys were seemingly unoccupied in the 1770s and 1780s. However, it was during the British occupation of Florida that Bahamians began to use the Keys seasonally for fishing, lumbering, and wrecking. Wrecking became a year round occupation for some with permanent camps established in the Keys. In addition, Havana had been surreptitiously monitoring the British military build-up in the colonies since the early 1770s and Cuban fishing vessels plying the Keys and Florida coast were an integral part of this network. By the start of the American Revolution, the Captain General at Havana operated as the chief of an intelligence gathering system that included various islands in the Gulf of Mexico (Cummins 1991). Thus, small vessels would have visited the Keys for fishing, cutting timber, salvaging ships, privateering or piracy, gathering of intelligence, and taking on provisions.

From the preliminary research, fishing by Cubans may have been the most common enterprise. The British documented as many as 300 to 400 Cuban fishermen in several dozen vessels during the 1760s (Cummins 1991). The presence of one stone and several lead fish net weights may be an indication of fishing. However, several of the lead weights are certainly of a later date and thus intrusive, and the stone weight was possibly part of the ballast. The musket balls and bird shot could indicate a military purpose; however, this light ordnance may have been used for hunting deer and wild birds to replenish the ship's provisions, or for personal defense. The two 20-pound bar shots and other examples of solid iron shot that Muir recovered could indicate the presence of cannon on board the vessel. The 18-pound shot halves, 18-pound round shot, and smaller examples of solid iron projectiles that Muir recovered could indicate the presence of artillery on board the vessel. This would seem unusual for a fishing vessel, but not for a privateer or small vessel engaged in military operations. Interestingly, the examples of 18-pound shot recovered from the wreck suggest that the vessel may have carried a relatively new and advanced form of armament. Most varieties of small eighteenth-century gun vessels, including sloops, sloops-of-war, brig-rigged sloops, gun-brigs, and corvettes, were armed with 2-,4-, and 6-pounder long guns as well as a complement of 1/2-pounder swivel guns (Archibald 1987:54). The final years of the American Revolution however, saw an increase in the use of *carronades* aboard small, armed watercraft. *Carronades* are short, light-barreled guns with large bores that could fire a heavy ball with crushing effect at short range. Following their introduction to the British Royal Navy in 1779, *carronades* enjoyed

a brief period of popularity, but were largely phased out by the middle of the nineteenth century due to their limited range (Archibald 1987:63 and Wilkinson-Latham 1973:17). During their heyday, 18-pounder *carronades* became the standard form of artillery aboard sloops and most other small, armed vessels (Wilkinson-Latham 1973:87). Not surprisingly, the diameter of each example of 18-pound shot recovered from the wreck closely matches the standard size of shot fired from 18-pounder *carronades* (Phillips 2000 and Petersen 1965:80). While it is likely that the iron shot recovered from the wreck was intended for use as ammunition, some or all of the assemblage could also have been stowed in the vessel as ballast or scrap.

The wood used in the vessel construction include Spanish cedar and yellow pine, which are native to the New World, specifically the Caribbean and Central America. New Spain shipbuilders are known to have incorporated different species of native wood in the construction of local ships and cedar was one of the chief timbers for this purpose (Clayton 1980:80). Pitch and cordage were also locally acquired. In Nicaragua, cordage was made from a local hemp-like plant (Clayton 1980:80).

There are some indications that the vessel was lost by tragedy rather than abandoned. The presence of artifacts such as the ceramics, sand glass, and coin would not be found on an abandoned vessel. Also, considering the vessel was lost in relatively shallow water, only 10 to 12 feet deep, whatever equipment and goods were on board could have been easily salvaged. As mentioned earlier, the British, Spanish, and French were at war during the second half of the eighteenth century. One interesting possibility for the loss of this vessel is its destruction in association with one of the wars. Many more vessels came to grief in these waters as the result of tropical storms or hurricanes. In 1780, the worst hurricane of the eighteenth century struck the Caribbean causing ships to wreck all the way up the northeastern coast of North America. Further historical and archaeological research may reveal more details about how this vessel came to be lost at Key West.

The Boca Chica Channel Wreck is one of the earliest archaeological sites from the historic period in the Florida Keys. Although it is a very fragile site located in shallow water, its archaeological integrity appears to be intact. It represents a period in Key West history that is not well known and from which archaeological sites are absent or have been destroyed. It also appears to represent a small vessel of a construction type not previously documented. Its possible destruction during the period of the American Revolution may indicate its association with that historic event, either as a privateer or as a Spanish naval vessel. Should this connection be proven, it would be an exceedingly important archaeological site. It is therefore determined to be eligible for listing on the NRHP under Criterion D, as a significant archaeological resource at the local, state, and possibly the national level.

Chapter Nine Recommendations

The site is significant to maritime archaeology, to state and regional history, and for further research. The Boca Chica Channel Wreck has potential to yield more archaeological information on a period of Florida Key history that is relatively unknown. A number of questions remain to be answered concerning this site: is it Spanish or French; when was the date of sinking; is it associated with a terrestrial site; what was the type and size of the vessel; was it wrecked or abandoned? Any further investigation should develop research questions and methodology for identifying the vessel's purpose, the crew's ethnicity, and the cause of its loss.

On December 3, 1997, Whall and Silvia checked the site for any disturbance. They were responding to a report that a dive boat was anchored near the site. There was no evidence of digging and no holes or evidence of disturbance. Most of the site appeared to be covered with stone and sediment. The one exception was an area of about eight square inches of planking exposed between the ballast stones on the southeastern end of one of the excavated areas. Therefore, there is a need to cover more of the site and to set up a program for periodic monitoring and protection.

It is remarkable that this wreck has survived at all considering the shallow water depth and the active diving community in the Florida Keys. Undoubtedly some depredations have occurred in the past. It is possible that dredging of the channel associated with the development of NAS Key West disturbed the site. However, the Navy's restrictions on access certainly prevented the site from being scavenged by collectors and treasure hunters. Environmental factors are also a threat because the site is only lightly covered with sediment. Muir's early site drawings show a great deal more hull present than was found during the 1997 survey. It is likely that where Muir exposed timbers, biological and environmental actions destroyed those exposed remains.

The Navy's restriction of the area has preserved it to date. However, because the base no longer has a security team around the area, Navy protection is not guaranteed. A site protection plan should be completed. The plan should incorporate the cooperation of the state of Florida and NOAA law enforcement officials. These agencies can question boaters anchored on or near the site and can make arrests. Because the site is located on Federally-owned bottomlands, the Archaeological Resources Protection Act (ARPA) applies. However, it will be up to NAS Key West personnel to follow up with formal charges against any illegal actions. Violations could and should be prosecuted under ARPA and Federal property laws. In addition, trespassing violations of the Navy's security zone should be prosecuted. NAS Key West should renew the sign prohibiting access within 100 feet of the shoreline. Mangroves now

obscure the present sign. This security plan should be prepared and effected before further work on the site is initiated.

NAS Key West should undertake the following five actions:

- prepare a nomination to list the site on the NRHP;
- coordinate with state of Florida officials and update the Florida Site File;
- develop security protocols in conjunction with NOAA and the Florida Marine Police. These agencies have been informed and asked to watch the site; however, formal procedures should be in place;
- post clear signage (e.g., No Trespassing) at the site to prevent unauthorized access and;
- develop a briefing paper regarding the history, management and protection of the site for new NAS Key West personnel so that new Navy personnel given authority over the wreck are knowledgeable. In other words, there should be a programmatic method within NAS Key West to transfer information and accountability for site management. GIS that relate all cultural and environmental resources with current facilities and proposed construction and dredging activities are ideal for this type of management and planning.

The Boca Chica Channel Wreck is important to local Key West history and has been the subject of much local interest in the past. It is important to develop a public education component concerning the shipwreck and the archaeological survey. This should be done in conjunction with the state of Florida, NOAA, the Navy, and local historic preservation groups.

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Appendix Two Artifact Inventory

EXCAVATION NO.	MATERIAL	OBJECT
BCC 97-01	organic	sample
BCC 97-02	rope	sample
BCC 97-03	lead and stone fragments	sheathing fragment
BCC 97-04, B-9	wood	sheave
BCC 97-05, W-9	glass	case bottle base
BCC 97-06, A-9	ceramic	three olive jar fragments
BCC 97-07, K-9	iron concretion	"gudgeon" (strap)
BCC 97-08	lead	oval fish weight
BCC 97-09, Q-6	ceramic	olive jar fragment
BCC 97-10, D-9	iron concretion	"staple"
BCC 97-11	ceramic	three sherds, patterned, white
BCC 97-12	iron concretion	iron
BCC 97-13, T-5	ceramic	tile or brick fragment
BCC 97-14, E-5	ceramic/conglomerate	two joining sherds
BCC 97-15	ceramic	sherd, coarseware ("rim")
BCC 97-16, B-5	ceramic	tile fragment
BCC 97-17 A	lead	round shot, 3 pieces
BCC 97-17 B	wood	fragment
BCC 97-18	ceramic	rim sherd, glazed
BCC 97-22 A, B-5	copper alloy	possible button core or tack
BCC 97-22 B, B-5	bone	fragments
BCC 97-22 C, B-5	ceramic	three sherds
BCC 97-22 D, B-5	glass	fragment
BCC 97-23	glass	sand glass
BCC 97-24	ceramic	two joined sherds, white
BCC 97-25, H-9	ceramic	rim sherd, plate
BCC 97-26 A	glass	bottle base
BCC 97-26 B	lead	shot
BCC 97-27 A	lead	shot
BCC 97-27 B	iron concretion nail	concretion
BCC 97-27 C	silver	coin
BCC 97-28	ceramic	sherd, black
BCC 97-29	ceramic	sherd, thin, glazed
BCC 97-30	ceramic	glazed sherd
BCC 97-31	ceramic	sherd, half bowl
BCC 97-33	iron concretion	mold, can or chainplate
BCC 97-34, A-5	lead	sheathing
BCC 97-35 A	ceramic	olive jar fragment
BCC 97-35 B	iron, epoxy	collar, Fe block
BCC 97-35 C	ceramic	glazed sherds
BCC 97-36	ceramic	glazed sherd
BCC 97-37	ceramic	glazed sherd
BCC 97-38	ceramic	sherd, transfer print
BCC 97-39	ceramic	sherd, earthenware
BCC 97-40	lead	shot, three round, eight pellet
BCC 97-41	lead	shot, six pieces
BCC 97-42	ceramic	plate, Rouen faience
BCC 97-43	ceramic	plate, intact, white
BCC 97-44	ceramic	glazed sherd, faience
BCC 97-45	ceramic	glazed sherd, stoneware
BCC 97-46	lead	two weights, teardrop
BCC 97-47	glass	aqua sherd, base
BCC 97-48	lead	sheathing, two pieces
BCC 97-49, G-2	lead	sheathing, seven pieces
BCC 97-50, E-9	lead	sheathing, one piece
BCC 97-51, F-5	brick	fragment
BCC 97-52, H-5	stone	shelly conglomerate
BCC 97-53, I-5	wood	fragment w/nail holes

BCC 97-54, K-2	glass	green base
BCC 97-55, L-2	glass	two green sherds
BCC 97-56, N-2	ceramic	glazed sherd
BCC 97-57, Q-5	ceramic	sherd, glazed
BCC 97-58, T-9	glass	bottle body, base, green
BCC 97-59 (BCC 1)	ceramic	unglazed fragment
BCC 97-60 (BCC 3)	ceramic	porcelain insulator
BCC 97-61 (BCC 4)	ceramic	two sherds, coarseware
BCC 97-62 (BCC 5)	stone	net weight
BCC 97-63 (BCC 6)	ceramic	sherds, two coarseware
BCC 97-64 (BCC 7)	stone	two fragments
BCC 97-65 (BCC 8)	lead	three fishing weights
BCC 97-66 (BCC 10)	wood	sample, buttress
BCC 97-67 (BCC 11)	wood	sample (UD)
BCC 97-68 (BCC 12)	wood	sample, treenail
BCC 97-69 (BCC 13)	wood	sample, mast step
BCC 97-70 (BCC 14)	wood	sample, step shim
BCC 97-71 (BCC 15)	wood	sample, ceiling
BCC 97-72 (BCC 16)	wood	sample, frame
BCC 97-73 (BCC 17)	wood	sample, red futtock
BCC 97-74 (BCC 18)	wood	sample, treenail
BCC 97-75, P-2 (BCC 19)	wood	sample, hull planking
BCC 97-76 (BCC 20)	wood	sample, footwale
BCC 97-77 (BCC 52)	pot metal	license plate
BCC 97-78 (BCC 53)	stone	eight ballast stones
BCC J-2	glass	bottle neck
BCC Muir 50	wood	treenails
BCC Muir 51	glass	case bottle base
BCC Muir 54	iron concretion	scissors
BCC Muir 55	iron concretion	spike crust
BCC Muir 56	iron concretion	spike
BCC Muir 57	iron	spike
BCC Muir 58	iron	"oar lock"
BCC Muir 59	iron	small verso shot
BCC Muir 60	stone, iron	stone w/ spike
BCC Muir 61A	iron	bar shot w/x-bar
BCC Muir 61B	iron	bar shot half
BCC Muir 62	iron	round shot, intact
BCC Muir 63	iron	round shot, spalled
BCC Muir 64	lead	shot, one piece
BCC Muir 65	bone	object
BCC Muir 66	copper-nickel	fork
BCC Muir 67	glass	goblet, blue
BCC Muir 68	plastic	bead
BCC Muir 69	copper alloy	tube (A) with cap (B)
BCC Muir 70	iron	small anchor fragments
BCC Muir 71	lead	sheathing, nine pieces
BCC Z-9	glass	bottle base

Appendix Three

Wood Analysis

BCC 10	Wood Sample. Buttress. Species in the yellow pine group (*Pinus*).
BCC 11	Wood Sample. Keelson. Species in the white oak group (*Quercus*).
BCC 12	Wood Sample. Treenail from frame next to mast step. Species in the white oak group (*Quercus*).
BCC 13	Wood Sample. Mast step. Species in the white oak group (*Quercus*).
BCC 14	Wood Sample. Shim from under the mast step. Species in the yellow pine group (*Pinus).*
BCC 15	Wood Sample. Ceiling fragment. Species in the yellow pine group (*Pinus*).
BCC 16	Wood Sample. Frame. Species in the white oak group (*Quercus*).
BCC 17	Wood Sample. Futtock. Spanish cedar (*Cedrela*).
BCC 18	Wood Sample. Treenail. Species in the white oak group. (*Quercus*).
BCC 19	Wood Sample. Hull planking. Spanish cedar (*Cedrela*).
BCC 20	Wood Sample. Footwale, near mast step. Species in the yellow pine group (*Pinus*).

Identified by Center for Wood Anatomy Research,
U.S. Forest Products Laboratory,
Madison, Wisconsin 53705

Appendix Four

Conservation Summary

Conservation Treatment and Analysis of Boca Chica Channel Wreck Artifacts

Freshly excavated objects were immediately placed in salt water and later transferred to fresh water.

Muir stored the artifacts he collected in his garage in both a dry and wet state for over a decade. The cannon balls were stored in water, while other artifacts had been kept dry for some time.

Upon delivery to the NHC Conservation Laboratory, most objects were inventoried and stored in deionized water. Iron objects were stored in 1% sodium hydroxide to prevent further corrosion. All objects were photographed on color and black-and-white film, and sometimes digitally, usually before and after treatment. Many were sketched 1:1 on Mylar drafting film before treatment.

Conservation treatments are discussed here according to material type. The descriptions below are summaries of treatments; full treatment records are on file at the NHC.

Most of the objects were covered in hard accretions consisting of marine organisms, sediment, and/or metal corrosion products. These were removed with a variety of small hand tools such as scalpels, dental picks, hammer and chisel, Vibrotool, and/or air scribe (pneumatic chisel). In some instances, dilute acid was used in spot applications to soften accretions.

All objects were desalinated in water baths, with the water quality monitored with a conductivity meter. Desalination was generally considered finished when consecutive readings were stable. Chloride ion content of alkaline solutions used for iron stabilization and desalination was measured with either a Quantab Chloride Titrator strip, or a LaMotte Chloride Test Kit (titration using potassium chromate and silver nitrate), after acidifying the sample to a neutral pH.

Some objects were analyzed by x-ray fluorescence in order to determine their elemental composition, at the Freer Gallery of Art, Smithsonian Institution and the Naval Research Laboratory.

Most objects after treatment were stored in self-seal ("Zip-lock") polyethylene bags inside wood drawers lined with polyethylene foam padding. Some are stored on supports or in boxes constructed of acid-free blueboard (thin corrugated board), with acid-free tissue or polyethylene foam padding. Objects are tagged with acid-free card tags. Objects with spe-

cial storage arrangements are noted below.

In most cases, the purpose of conservation treatment was to reveal diagnostic surfaces and manufacturing details to interpret the objects more fully. Also, since the objects were weakened by approximately 200 years of immersion in salt water, treatment included drying and stabilization to make the objects easily available for study and display.

Ceramics

Ceramics and tiles were generally stable, but covered with algae growth, calcareous concretions, and red, yellow, brown, black, and red-brown stains. Glazed surfaces were usually worn, chipped, and/or crizzled. Calcareous concretions were removed mechanically with a scalpel, or where necessary by local drops of 1-5% hydrochloric acid, or by short immersion in 2-5% nitric acid, followed by further mechanical cleaning. The sherds were thoroughly rinsed in changes of deionized water to remove any traces of acids and soluble salts, then air-dried. It is recommended that acids be used only locally on ceramics if mechanical cleaning alone will not remove the concretions, as the acid can remove components of the ceramic itself.

The Rouen plate (97-42) was immersed in 5% hydrochloric acid for a total of two minutes, alternating with brushing to remove loosened deposits. It is not clear if this has caused a slight dulling of the glaze. As noted in a previous chapter, x-ray fluorescence analysis of the glaze showed it to be composed primarily of lead, with a small proportion of tin.

Most stains were successfully removed by soaking the ceramic in 6% hydrogen peroxide, or in 3% hydrogen peroxide buffered with 3-6% ammonium hydroxide, for one day to one week.

Ceramic fragments 97-11, and 97-35, 97-36, and 97-37 could be reconstructed. Break edges were first sealed by coating with dilute (5%) Acryloid B72 acrylic resin in acetone. The sherds were then adhered together with concentrated Acryloid B72 acrylic resin in acetone. Acryloid B72 is a synthetic polymer that has been shown to be stable over a long period of time, so is suitable for use on historic materials.

Glass

Glass objects were generally stable, but covered in some white calcareous accretions and slimy black deposits. Some had worn, thinned edges.

Accretions were removed mechanically with a scalpel, and with droplets of 5% nitric and formic acids where they were particularly tenacious.

After thorough rinsing, the objects were slowly air-dried inside polyethylene bags to avoid cracking and surface loss.

After drying, one of the square bottle bases (Muir 51) showed significant evidence of glass deterioration in the form of delaminating layers and reduced translucency. This bottle base may have dried out at some point during storage at Muir's house. The deterioration was not visible when the glass was in water, as the layers were saturated. The delaminating layers can be consolidated with dilute Acryloid B72 acrylic consolidant.

During desalination in water, sandglass 97-23 developed needle-like crystals on its interior. A spot test for the presence of lead in these crystals was positive, indicating a lead content in the glass.

The robust glass objects were brushed with a toothbrush, rinsed, and slowly dried.

Stone

The stone objects from the site were robust, so they were simply desalinated and dried.

Lead

Lead caulking strips were heavily coated with marine accretions combined with grey-white lead corrosion products and red-brown iron staining; they were also folded, bent, and fragile. Lead round shot were in varying states, some smooth and well preserved, others with dents and areas of surface loss, and covered partially with white, beige, and yellow lead corrosion products and marine concretion. Lead fishing weights were less corroded and concreted. Since mechanical cleaning of lead can often lead to damage to the soft lead surface, chemical and electrochemical methods were also used to reveal the surfaces of the objects.

Most fragments of lead sheathing were treated by electrolytic reduction in 5% sulfuric acid electrolyte, using a carbon steel anode, at 2-4 volts and equivalent amperage. This was followed by extensive rinsing in baths of deionized water, combined with mechanical cleaning with a toothbrush and a glass-bristle brush to remove all accretions. After air-drying, the objects were rinsed with acetone, then coated with Incralac acrylic lacquer followed by Renaissance microcrystalline wax. Some fragments broke along weakened folds. Several caulking strips remain untreated.

One piece of lead caulking (97-43) was treated by soaking in alternating baths of 2% disodium EDTA (ethylene diamine tetra-acetic acid) and 2% sulfuric acid, combined with mechanical cleaning, to remove accretions and iron staining.

Lead shot were treated by removing accretions with a scalpel and toothbrush, then hot washing in several changes of nearly boiling deionized water. Lead is known to corrode in soft, acidic water, but no additional corrosion was noted during this treatment. However, chloride levels of the wash solutions were found to be erratic. After air-drying, final mechanical cleaning was accomplished with toothbrushes. After rinsing in acetone, the objects were coated as described for the lead caulking. Some lead shot (97-27a) were treated by electrolysis as described above for lead strips. Some (97-27a) were also soaked in 5% disodium EDTA, but this solution appeared to soften and etch the lead surface, so this treatment was discontinued.

Lead fishing weights were treated by soaking in 5% disodium EDTA and cleaned mechanically. After drying, they were coated as described above.

All lead objects have been stored in metal cabinets rather than wood to prevent the lead corrosion that is commonly caused by the organic acids emitted by wood.

Iron

Iron objects were in varying states of preservation. Those freshly excavated from the site were coated in a thick, hard, obscuring concretion consisting of marine accretions, sediment, and corrosion products. Usually these concretions fully obscured the surface and even the shape of the object. The objects that had been collected by Muir were mostly free of accretions, with much loss of original surface and corroded metal cores visible.

Fully concreted iron objects were x-rayed to see their shapes and to determine if any iron metal remained. Usually little or no metal remained, so those concretions were broken open in a controlled manner, the powdery corrosion products cleaned out, and the hollow voids cast with Hysol two-part liquid epoxy with some iron oxide powder added. After the epoxy had hardened inside the concretion, the outer concretion layers were removed with an air scribe to reveal the epoxy cast. This technique resulted in exact replicas of the original iron objects that had fully deteriorated away. Original shapes and surface details have been well preserved with this technique. If any metal cores remained inside these concretions, they were removed prior to casting, and were treated in the same manner as the other iron objects (below). The concreted scissors have not yet been cast.

Iron objects collected by Muir were stored in the NHC lab in 1% sodium hydroxide solution to prevent further corrosion until treatment began. Several wrought iron objects and one cast iron shot were treated by immersion in a strongly reducing alkaline dithionite solution (sodium

dithionite plus sodium hydroxide), followed by extensive rinsing, dewatering in ethanol, coating with tannic acid, drying, and brushing with acrylic lacquer and microcrystalline wax for protection. This treatment was only partially successful. Iron oxidation recommenced on some of the objects, possibly due to premature oxidation of the solution, or to improper application of the treatment. Some objects still had thick layers of accretion on the surface, which may have prevented access of the reducing solution to the metal surface. Also, the treatment may not have been carried out long enough, so that corrosive chlorides were not fully removed. Some of these objects had to be re-treated. Accretions were removed mechanically with a scalpel and by air-abrading with walnut shells (the latter was ineffective on the hard accretions). Then the objects were put into electrolysis with sodium hydroxide electrolyte and a steel anode to remove chlorides and remaining accretions. After extensive rinsing in hot water to remove alkaline residues, the objects were dewatered and coated as above. If not carried out carefully, electrolysis has the disadvantage that it can remove soft, corroded surface layers that may retain original surface markings and shapes. Small cast iron shot (Muir 59), which cracked apart in dry storage after alkaline dithionite treatment, was re-treated by passive soaking in changes of 1% sodium hydroxide instead of by electrolysis.

Four pieces of round shot and bar shot ends collected by Muir were problematic. Three cracked during electrolysis treatment; the fourth (Muir 63) is broken into many pieces, but it is not clear when this happened. Of the three that cracked during electrolysis, Muir 62 remained intact, two pieces of the edge of 61B cracked off, and Muir 61A cracked apart into many pieces. Round shot are known to break apart during and after treatment, probably due to corrosion formation at the surface of a remaining metal core beneath the layers of corrosion products, in this case graphitized cast iron. It is also possible that these shot had dried out during their 20 years of storage since excavation. After electrolysis was halted, the objects were passively treated by soaking in changes of 1% sodium hydroxide until chloride levels were low and stable. They were then rinsed, dewatered, coated with tannic acid, dried, and brushed with acrylic lacquer and microcrystalline wax. The shot that have fallen apart are awaiting reconstruction. The pieces of iron do not fit together precisely any more, due to "springing" (warping) of the fragments.

The Iron anchor (Muir 70) is in a highly deteriorated condition. It is dry and the remaining metal core has cracked apart due to continued corrosion, leading to disintegration of the object. This fragmented object is stored in a low relative humidity environment to prevent further corrosion.

Silver

The single silver object from the shipwreck was a coin concreted together

with other objects. Its surface was completely obscured by hard, dark grey corrosion products. X-radiography did not reveal any markings that might be preserved on the surface to identify the coin; it did show that the edges were damaged and corroded. The coin proved quite difficult to treat, and underwent mechanical, electrolytic, and chemical cleaning to reveal its surface. X-ray fluorescence analysis showed the coin to be primarily silver, with smaller contents of copper and zinc. The spectrum also had small peaks of iron and strontium.

Initial treatment by electrolysis in a sodium carbonate electrolyte at low voltage and amperage both revealed, and then destroyed, surface markings on the edge of the coin, possibly due to the evolution of hydrogen bubbles below the soft, corroded surface that preserved the markings. After electrolysis was halted, the remaining calcareous accretions were removed with dilute hydrochloric acid, and the coin was placed in a strongly reducing alkaline dithionite solution. As with electrolysis, this treatment both revealed, then destroyed the surface markings around the highly corroded edge. The edges of the coin were left exposed, soft, and crumbly.

Treatment continued by mechanically removing with a scalpel the hard deposit of reduced silver on the central areas of both sides, to reveal the remnants of a design on one side. It was clear that no further detail could be found on the other side. Some green copper corrosion that developed during water rinsing was partially removed with drops of 10% formic acid. After rinsing, the coin was dewatered in ethanol, immersed in corrosion inhibitor benzotriazole (BTA) in ethanol, and slowly air-dried. Because the coin was fragile and crumbly when dry, it was immersed in dilute Acryloid B72 consolidant to strengthen it and protect the surface.

Copper Alloy

The small, still unidentified copper alloy object (97-22) from the site was mechanically cleaned with a scalpel to remove obscuring corrosion products. After dewatering in ethanol, it was immersed in 3% BTA in ethanol, then allowed to dry. It was immersed in dilute Acryloid B72 in acetone to consolidate and coat it, then brushed with microcrystalline wax.

The copper alloy fork collected by Muir was initially thought to be a silver-copper alloy, due to the green and red corrosion over a metallic silver-colored base. The surface of the object was heavily corroded and pitted, with much metal loss. During treatment with formic acid to remove copper corrosion products, it became apparent that the metal was not reacting in the manner of a silver-copper alloy. After analysis by x-ray fluorescence revealed the object to be a copper-nickel alloy, it was treated

similar to a brass object. Remaining corrosion and newly formed corrosion products were removed by swabbing with 5% citric acid, followed by brushing with a glass bristle brush to reveal a silvery-colored surface. The surface was further polished with a calcium carbonate slurry, then rinsed, immersed in the copper corrosion inhibitor BTA in ethanol, dried, then brush-coated with acrylic lacquer and wax.

The unidentified copper alloy tube and cap (Muir 69) had been dried in the past. The tube was filled with sediment, insect egg casings, and copper corrosion flakes. The objects were treated by immersing in changes of deionized water. Debris was removed, then they were dried and coated as the other copper alloy objects.

Organics

The wood sheave excavated from the shipwreck was in good condition overall, but had some damage caused by small burrowing organisms, and had worn edges and a soft surface. Parallel saw-marks were visible on one flat surface. The other small wood fragments that had been part of larger concretions were worn and mostly undiagnostic.

Most of the wood excavated from the shipwreck was treated by immersing in polyethylene glycol (PEG) of molecular weights 400 and 3350 for several months, followed by freeze-drying, or air drying in the case of the smaller fragments. They were stored in stable microenvironments (sealed or closed acid-free boxes and polyethylene bags) to prevent cracking or other problems caused by fluctuations in relative humidity.

Wood samples taken for species identification have been identified and are now soaking in water. They may be treated as above, to avoid permanent wet storage.

Five wood treenails collected by Muir were in warped and collapsed condition, but were in water storage. It is probable that they had dried out in the past, then were put back into water. Re-immersing them, however, did not restore their original shape, as drying out causes irreversible collapse of the wood cell walls. Since the wood had already been considerably damaged due to drying out, it was not clear if the standard PEG immersion treatment to prevent cell wall collapse would be useful. Therefore, these treenails were used for different test treatments, to see if one would produce better results. Two treenails were very slowly air-dried in double polyethylene bags, and one was solvent dried through baths of ethanol and water, gradually increasing the proportion of ethanol to 100%, then slowly air-dried. These treatments produced further shrinkage and splitting of the treenails, somewhat unexpectedly. Therefore, the remaining two treenails were treated with the standard PEG/freeze-dry method, with no further shrinkage.

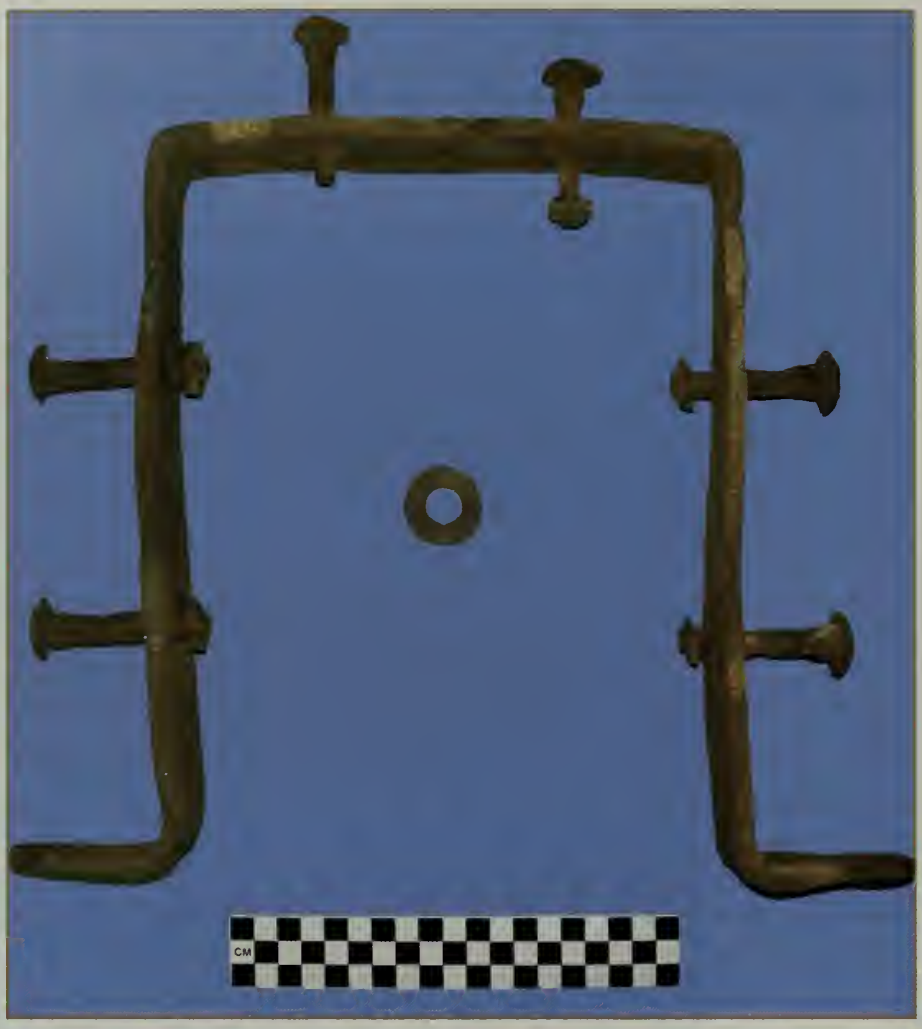
The single bone object was cracked and iron-stained. As a test treatment, the bone was soaked in 5% ammonium citrate to remove iron staining, but this seemed to soften the bone, so was not continued. The bone was desalinated, then dried through baths of ethanol, followed by slow air drying.

Modern Materials

The plastic bead was immersed in water, brushed and dried. The license plate, possibly made of potmetal, is dry and has not yet been treated.

Appendix Five Artifact Photographs

97-49 • Lead sheathing strips.



97-07 • Epoxy cast of the 'U'-shaped strap-like object originally composed of a wrought iron band with hand-made fasteners; and 97-10 • Epoxy cast of an iron "staple" concretion mold.

Figures 97-35B • Epoxy cast of a boom iron; and 97-04 • Lignum vitae *block sheave.*

• *97-17A*
Three round lead shot.
• *97-26B*
Lead shot.
• *97-27A*
Lead shot.

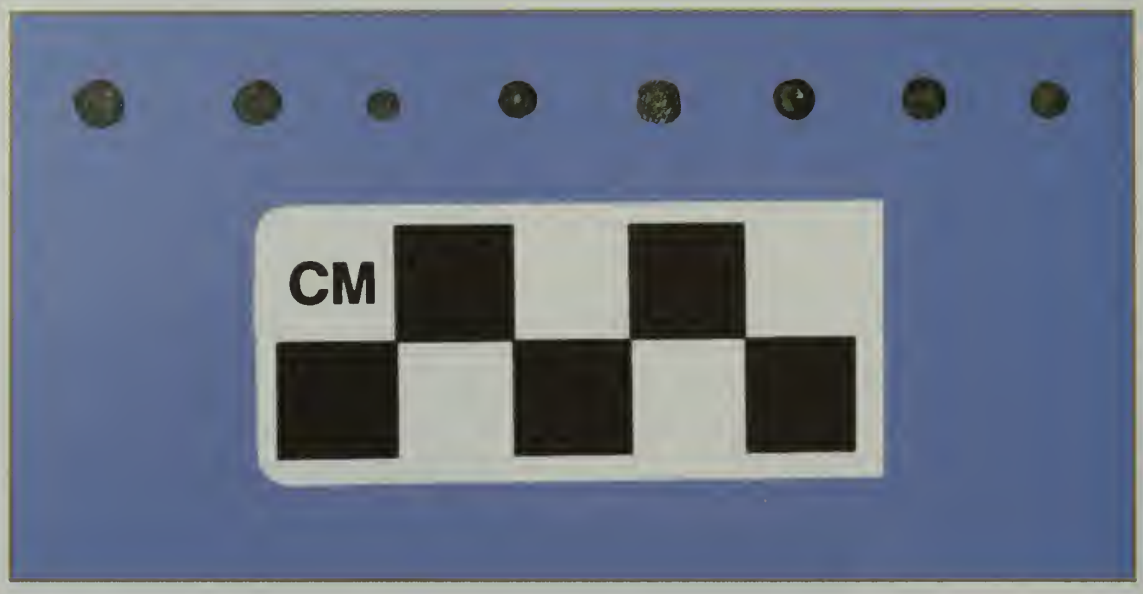
- *97-40 Three round lead shot.*
- *97-41 Six round lead shot.*
- *Muir 64 Lead shot.*

Muir 59 • Smallest iron shot collected by Muir.

Muir 62 • Large iron shot collected by Muir.

Muir 63 • Largest iron shot collected by Muir, shown without the spalled surface fragments.

97-40 • Eight round shot lead pellets.



Muir 61A • Fragmentary bar shot.

97-35C, 97-36, 97-37 • Reconstructed fragments of a Spanish El Morro *earthenware jar with handle.*

97-42 • Rouen blue-on-white faience plate.

97-44 • A sherd of blue-on-white tin-glazed earthenware with buff colored paste.

97-56 • (top) Body sherd of pale blue-on-white, glazed earthenware with buff paste.

97-38 • (bottom) A sherd of transfer-printed pearlware with chinoiserie *characteristics incorporating a blue-on-white floral spray decoration.*

97-06 • Two sides of an olive jar fragment.

97-09 • (top) Large non-diagnostic earthenware body sherd.

97-39 • (bottom) Large sherd from near the base of an olive jar with reddish paste and heavy ridges.

97-05 • The base of a square-sectioned olive green glass bottle with a rough pontil mark.

97-47 • (top) A large blue glass fragment may represent the base of a demi-john bottle.

97-26A • (bottom) The base of a finely crafted, small pale green glass bottle.

97-08 • (top) Lead fishing weight.

97-65 • (bottom) Lead fishing weights.

97-62 • (top) Possible limestone fishing-net weight.

97- 46 • (bottom) Two teardrop lead fishing weights.

Muir 54 • (top) A pair of heavily-concreted scissors.

97-23 • (bottom) A globe from a sandglass.

97-27C • Poorly-preserved silver coin, reverse.

97-13 • One flat tile.

97-16 • (top) Tile with a foot.

97-51 • (bottom) Broken red brick.

Muir 67 • Blue glass goblet.

97-60 • (top) Porcelain insulator.

97-45 • (bottom) Tan-glazed stoneware.

97-43 • Whiteware bowl with a blurry maker's mark on the base.

97-31 • (top) Whiteware bowl with a scalloped rim. (inset) Maker's mark.

97-25 • (bottom) Whiteware bowl fragment. (inset) Maker's mark.

97-11 and 97-24 • Whiteware bowl fragments. 97-24M • (inset) Maker's mark.

97-30 • Blue tranfer-printed, shallow-brimmed whiteware plate with a scalloped rim.

97-55 • Olive green bottle neck and shoulder.

97-58 • Olive green glass bottle base.

Muir 68 • (top) Blue plastic bead.

Muir 66 • (bottom) A four-tined copper-nickel alloy fork, most likely modern.

97-77 • (top) Grey metal plate possibly an automobile license plate frame.

97-22A • (bottom) Small copper alloy object.

Muir 69A and B • (top) Copper alloy tube with cap.

97-15 • (bottom) Coarseware rim sherd.

97-22C • (top)
Ceramic sherds.

97-22D • (bottom)
Glass fragment.

97-28 • (top) Black ceramic sherd.

97-29 • (bottom) Glazed ceramic sherd.

97-57 • Ceramic glazed sherd.

97-18 • Glazed ceramic rim sherd.

97-59 • (top) Unglazed stoneware fragment.

97-61 • (bottom) Two coarseware sherds.

97-63 • (top) Two ceramic coarse-ware sherds.

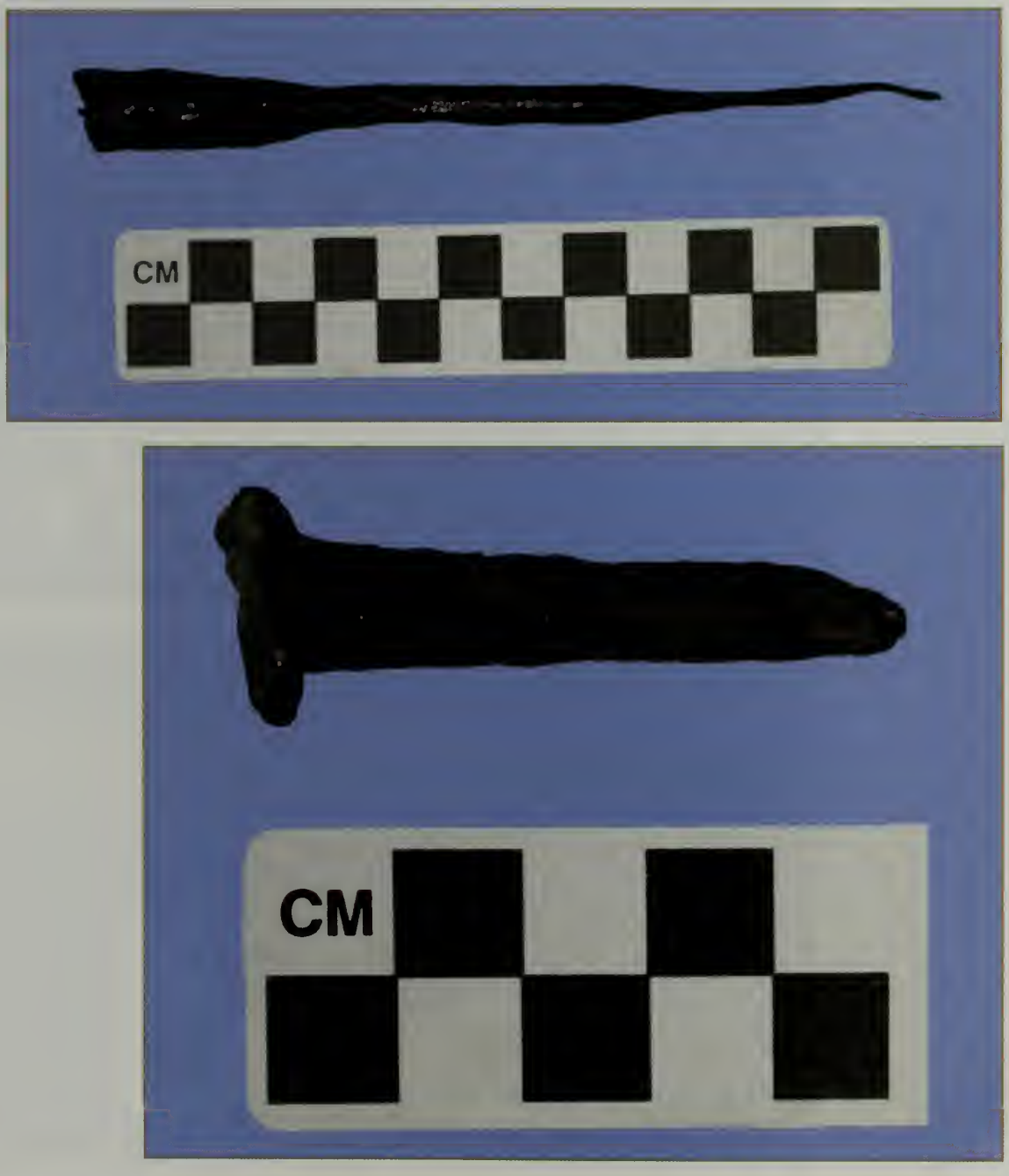
97-64 • (bottom) Possible ballast fragments.

97-78 • (top) A selection of ballast stones.

97-52 • (bottom right) Shelly conglomerate.

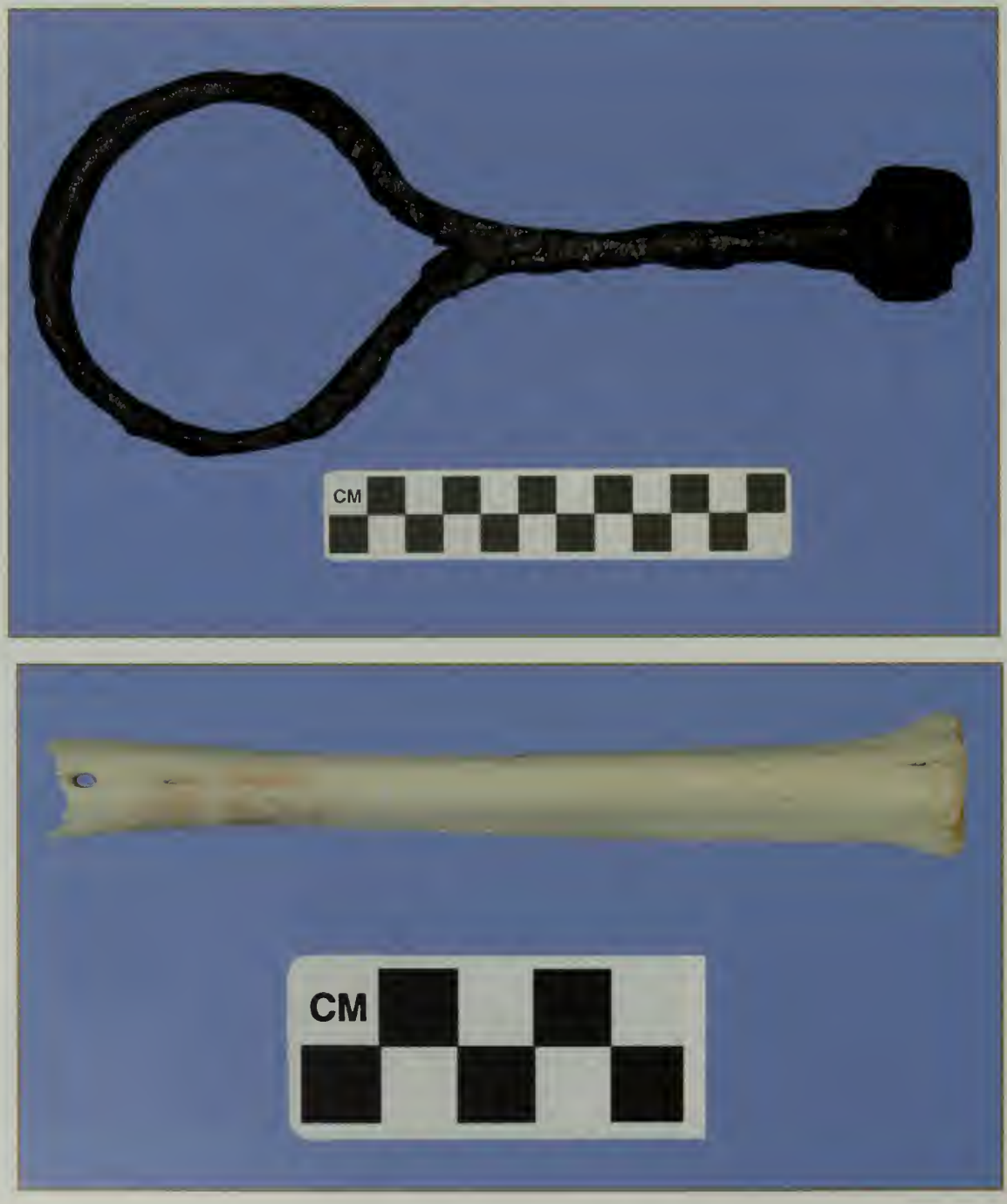
Muir 57 • (top) Iron spike.

97-27B • (bottom) Epoxy cast of an iron nail.



Muir 58 • (top) Possible iron oar lock.

Muir 65 • (bottom) Animal bone.



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BOCA CHICA CHANNEL WRECK SITE MAP (1997)